

ANNEX I
SUMMARY OF PRODUCT CHARACTERISTICS

1. NAME OF THE MEDICINAL PRODUCT

Glivec 400 mg film-coated tablets

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each film-coated tablet contains 400 mg imatinib (as mesilate).

For a full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Film-coated tablet

Very dark yellow to brownish-orange, ovaloid, biconvex film-coated tablet with bevelled edges, debossed with “NVR” on one side and “SL” on the other side.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

Glivec is indicated for the treatment of

- adult and paediatric patients with newly diagnosed Philadelphia chromosome (bcr-abl) positive (Ph+) chronic myeloid leukaemia (CML) for whom bone marrow transplantation is not considered as the first line of treatment.
- adult and paediatric patients with Ph+ CML in chronic phase after failure of interferon-alpha therapy, or in accelerated phase or blast crisis.
- adult patients with newly diagnosed Philadelphia chromosome positive acute lymphoblastic leukaemia (Ph+ ALL) integrated with chemotherapy.
- adult patients with relapsed or refractory Ph+ ALL as monotherapy.
- adult patients with myelodysplastic/myeloproliferative diseases (MDS/MPD) associated with platelet-derived growth factor receptor (PDGFR) gene re-arrangements.
- adult patients with advanced hypereosinophilic syndrome (HES) and/or chronic eosinophilic leukaemia (CEL) with FIP1L1-PDGFR α rearrangement.

The effect of Glivec on the outcome of bone marrow transplantation has not been determined.

Glivec is indicated for

- the treatment of adult patients with Kit (CD 117) positive unresectable and/or metastatic malignant gastrointestinal stromal tumours (GIST).
- the adjuvant treatment of adult patients who are at significant risk of relapse following resection of Kit (CD117)-positive GIST. Patients who have a low or very low risk of recurrence should not receive adjuvant treatment.
- the treatment of adult patients with unresectable dermatofibrosarcoma protuberans (DFSP) and adult patients with recurrent and/or metastatic DFSP who are not eligible for surgery.

In adult and paediatric patients, the effectiveness of Glivec is based on overall haematological and cytogenetic response rates and progression-free survival in CML, on haematological and cytogenetic response rates in Ph+ ALL, MDS/MPD, on haematological response rates in HES/CEL and on objective response rates in adult patients with unresectable and/or metastatic GIST and DFSP and on recurrence-free survival in adjuvant GIST. The experience with Glivec in patients with MDS/MPD associated with PDGFR gene re-arrangements is very limited (see section 5.1). Except in newly

diagnosed chronic phase CML, there are no controlled trials demonstrating a clinical benefit or increased survival for these diseases.

4.2 Posology and method of administration

Therapy should be initiated by a physician experienced in the treatment of patients with haematological malignancies and malignant sarcomas, as appropriate.

For doses other than 400 mg and 800 mg (see dosage recommendation below) a 100 mg divisible tablet is available.

The prescribed dose should be administered orally with a meal and a large glass of water to minimise the risk of gastrointestinal irritations. Doses of 400 mg or 600 mg should be administered once daily, whereas a daily dose of 800 mg should be administered as 400 mg twice a day, in the morning and in the evening.

For patients unable to swallow the film-coated tablets, the tablets may be dispersed in a glass of mineral water or apple juice. The required number of tablets should be placed in the appropriate volume of beverage (approximately 50 ml for a 100 mg tablet, and 200 ml for a 400 mg tablet) and stirred with a spoon. The suspension should be administered immediately after complete disintegration of the tablet(s).

Posology for CML in adult patients

The recommended dosage of Glivec is 400 mg/day for patients in chronic phase CML. Chronic phase CML is defined when all of the following criteria are met: blasts < 15% in blood and bone marrow, peripheral blood basophils < 20%, platelets > 100 x 10⁹/l.

The recommended dosage of Glivec is 600 mg/day for patients in accelerated phase. Accelerated phase is defined by the presence of any of the following: blasts ≥ 15% but < 30% in blood or bone marrow, blasts plus promyelocytes ≥ 30% in blood or bone marrow (providing < 30% blasts), peripheral blood basophils ≥ 20%, platelets < 100 x 10⁹/l unrelated to therapy.

The recommended dose of Glivec is 600 mg/day for patients in blast crisis. Blast crisis is defined as blasts ≥ 30% in blood or bone marrow or extramedullary disease other than hepatosplenomegaly.

Treatment duration: In clinical trials, treatment with Glivec was continued until disease progression. The effect of stopping treatment after the achievement of a complete cytogenetic response has not been investigated.

Dose increases from 400 mg to 600 mg or 800 mg in patients with chronic phase disease, or from 600 mg to a maximum of 800 mg (given as 400 mg twice daily) in patients with accelerated phase or blast crisis may be considered in the absence of severe adverse drug reaction and severe non-leukaemia-related neutropenia or thrombocytopenia in the following circumstances: disease progression (at any time); failure to achieve a satisfactory haematological response after at least 3 months of treatment; failure to achieve a cytogenetic response after 12 months of treatment; or loss of a previously achieved haematological and/or cytogenetic response. Patients should be monitored closely following dose escalation given the potential for an increased incidence of adverse reactions at higher dosages.

Posology for CML in children

Dosing for children should be on the basis of body surface area (mg/m²). The dose of 340 mg/m² daily is recommended for children with chronic phase CML and advanced phase CML (not to exceed the total dose of 800 mg). Treatment can be given as a once daily dose or alternatively the daily dose may be split into two administrations – one in the morning and one in the evening. The dose recommendation is currently based on a small number of paediatric patients (see sections 5.1 and 5.2). There is no experience with the treatment of children below 2 years of age.

Dose increases from 340 mg/m² daily to 570 mg/m² daily (not to exceed the total dose of 800 mg) may be considered in children in the absence of severe adverse drug reaction and severe non-leukaemia-related neutropenia or thrombocytopenia in the following circumstances: disease progression (at any time); failure to achieve a satisfactory haematological response after at least 3 months of treatment; failure to achieve a cytogenetic response after 12 months of treatment; or loss of a previously achieved haematological and/or cytogenetic response. Patients should be monitored closely following dose escalation given the potential for an increased incidence of adverse reactions at higher dosages.

Posology for Ph+ ALL

The recommended dose of Glivec is 600 mg/day for patients with Ph+ ALL. Haematological experts in the management of this disease should supervise the therapy throughout all phases of care.

Treatment schedule: On the basis of the existing data, Glivec has been shown to be effective and safe when administered at 600 mg/day in combination with chemotherapy in the induction phase, the consolidation and maintenance phases of chemotherapy (see section 5.1) for adult patients with newly diagnosed Ph+ ALL. The duration of Glivec therapy can vary with the treatment programme selected, but generally longer exposures to Glivec have yielded better results.

For adult patients with relapsed or refractory Ph+ALL Glivec monotherapy at 600 mg/day is safe, effective and can be given until disease progression occurs.

Posology for MDS/MPD

The recommended dose of Glivec is 400 mg/day for patients with MDS/MPD.

Treatment duration: In the only clinical trial performed up to now, treatment with Glivec was continued until disease progression (see section 5.1). At the time of analysis, the treatment duration was a median of 47 months (24 days - 60 months).

Posology for HES/CEL

The recommended dose of Glivec is 100 mg/day for patients with HES/CEL.

Dose increase from 100 mg to 400 mg may be considered in the absence of adverse drug reactions if assessments demonstrate an insufficient response to therapy.

Treatment should be continued as long as the patient continues to benefit.

Posology for GIST

The recommended dose of Glivec is 400 mg/day for patients with unresectable and/or metastatic malignant GIST.

Limited data exist on the effect of dose increases from 400 mg to 600 mg or 800 mg in patients progressing at the lower dose (see section 5.1).

Treatment duration: In clinical trials in GIST patients, treatment with Glivec was continued until disease progression. At the time of analysis, the treatment duration was a median of 7 months (7 days to 13 months). The effect of stopping treatment after achieving a response has not been investigated.

The recommended dose of Glivec is 400 mg/day for the adjuvant treatment of adult patients following resection of GIST. Optimal treatment duration is not yet established. Length of treatment in the clinical trial supporting this indication was 12 months.

Posology for DFSP

The recommended dose of Glivec is 800 mg/day for patients with DFSP.

Dose adjustment for adverse reactions

Non-haematological adverse reactions

If a severe non-haematological adverse reaction develops with Glivec use, treatment must be withheld until the event has resolved. Thereafter, treatment can be resumed as appropriate depending on the initial severity of the event.

If elevations in bilirubin > 3 x institutional upper limit of normal (IULN) or in liver transaminases > 5 x IULN occur, Glivec should be withheld until bilirubin levels have returned to < 1.5 x IULN and transaminase levels to < 2.5 x IULN. Treatment with Glivec may then be continued at a reduced daily dose. In adults the dose should be reduced from 400 to 300 mg or from 600 to 400 mg, or from 800 mg to 600 mg, and in children from 340 to 260 mg/m²/day.

Haematological adverse reactions

Dose reduction or treatment interruption for severe neutropenia and thrombocytopenia are recommended as indicated in the table below.

Dose adjustments for neutropenia and thrombocytopenia:

HES/CEL (starting dose 100 mg)	ANC $< 1.0 \times 10^9/l$ and/or platelets $< 50 \times 10^9/l$	<ol style="list-style-type: none">1. Stop Glivec until ANC $\geq 1.5 \times 10^9/l$ and platelets $\geq 75 \times 10^9/l$.2. Resume treatment with Glivec at previous dose (i.e. before severe adverse reaction).
Chronic phase CML, MDS/MPD and GIST (starting dose 400 mg) HES/CEL (at dose 400 mg)	ANC $< 1.0 \times 10^9/l$ and/or platelets $< 50 \times 10^9/l$	<ol style="list-style-type: none">1. Stop Glivec until ANC $\geq 1.5 \times 10^9/l$ and platelets $\geq 75 \times 10^9/l$.2. Resume treatment with Glivec at previous dose (i.e. before severe adverse reaction).3. In the event of recurrence of ANC $< 1.0 \times 10^9/l$ and/or platelets $< 50 \times 10^9/l$, repeat step 1 and resume Glivec at reduced dose of 300 mg.
Paediatric chronic phase CML (at dose 340 mg/m ²)	ANC $< 1.0 \times 10^9/l$ and/or platelets $< 50 \times 10^9/l$	<ol style="list-style-type: none">1. Stop Glivec until ANC $\geq 1.5 \times 10^9/l$ and platelets $\geq 75 \times 10^9/l$.2. Resume treatment with Glivec at previous dose (i.e. before severe adverse reaction).3. In the event of recurrence of ANC $< 1.0 \times 10^9/l$ and/or platelets $< 50 \times 10^9/l$, repeat step 1 and resume Glivec at reduced dose of 260 mg/m².
Accelerated phase CML and blast crisis and Ph+ ALL (starting dose 600 mg)	^a ANC $< 0.5 \times 10^9/l$ and/or platelets $< 10 \times 10^9/l$	<ol style="list-style-type: none">1. Check whether cytopenia is related to leukaemia (marrow aspirate or biopsy).2. If cytopenia is unrelated to leukaemia, reduce dose of Glivec to 400 mg.3. If cytopenia persists for 2 weeks, reduce further to 300 mg.4. If cytopenia persists for 4 weeks and is still unrelated to leukaemia, stop Glivec until ANC $\geq 1 \times 10^9/l$ and platelets $\geq 20 \times 10^9/l$, then resume treatment at 300 mg.

Paediatric accelerated phase CML and blast crisis (starting dose 340 mg/m ²)	^a ANC < 0.5 x 10 ⁹ /l and/or platelets < 10 x 10 ⁹ /l	<ol style="list-style-type: none"> 1. Check whether cytopenia is related to leukaemia (marrow aspirate or biopsy). 2. If cytopenia is unrelated to leukaemia, reduce dose of Glivec to 260 mg/m². 3. If cytopenia persists for 2 weeks, reduce further to 200 mg/m². 4. If cytopenia persists for 4 weeks and is still unrelated to leukaemia, stop Glivec until ANC ≥ 1 x 10⁹/l and platelets ≥ 20 x 10⁹/l, then resume treatment at 200 mg/m².
DFSP (at dose 800 mg)	ANC < 1.0 x 10 ⁹ /l and/or platelets < 50 x 10 ⁹ /l	<ol style="list-style-type: none"> 1. Stop Glivec until ANC ≥ 1.5 x 10⁹/l and platelets ≥ 75 x 10⁹/l. 2. Resume treatment with Glivec at 600 mg. 3. In the event of recurrence of ANC < 1.0 x 10⁹/l and/or platelets < 50 x 10⁹/l, repeat step 1 and resume Glivec at reduced dose of 400 mg.
ANC = absolute neutrophil count ^a occurring after at least 1 month of treatment		

Paediatric use: There is no experience in children with CML below 2 years of age (see section 5.1). There is limited experience in children with Ph+ ALL and very limited experience in children with MDS/MPD and DFSP. There is no experience in children or adolescents with GIST and HES/CEL.

Hepatic insufficiency: Imatinib is mainly metabolised through the liver. Patients with mild, moderate or severe liver dysfunction should be given the minimum recommended dose of 400 mg daily. The dose can be reduced if not tolerated (see sections 4.4, 4.8 and 5.2).

Liver dysfunction classification:

Liver dysfunction	Liver function tests
Mild	Total bilirubin: = 1.5 ULN AST: >ULN (can be normal or <ULN if total bilirubin is >ULN)
Moderate	Total bilirubin: >1.5–3.0 ULN AST: any
Severe	Total bilirubin: >3–10 ULN AST: any

ULN = upper limit of normal for the institution

AST = aspartate aminotransferase

Renal insufficiency: Since the renal clearance of imatinib is negligible, a decrease in free imatinib clearance is not expected in patients with renal insufficiency. Patients with mild or moderate renal dysfunction (creatinine clearance = 20–59 ml/min) should be given the minimum recommended dose of 400 mg daily as starting dose. Although very limited information is available, patients with severe renal dysfunction (creatinine clearance = < 20 ml/min) or on dialysis could also start at the same dose of 400 mg. However, in these patients caution is recommended. The dose can be reduced if not tolerated, or increased for lack of efficacy (see sections 4.4 and 5.2).

Elderly patients: Imatinib pharmacokinetics have not been specifically studied in the elderly. No significant age-related pharmacokinetic differences have been observed in adult patients in clinical trials which included over 20% of patients age 65 and older. No specific dose recommendation is necessary in the elderly.

4.3 Contraindications

Hypersensitivity to the active substance or to any of the excipients.

4.4 Special warnings and precautions for use

When Glivec is co-administered with other medicinal products, there is a potential for drug interactions (see section 4.5).

Concomitant use of imatinib and medicinal products that induce CYP3A4 (e.g. dexamethasone, phenytoin, carbamazepine, rifampicin, phenobarbital or *Hypericum perforatum*, also known as St. John's Wort) may significantly reduce exposure to Glivec, potentially increasing the risk of therapeutic failure. Therefore, concomitant use of strong CYP3A4 inducers and imatinib should be avoided (see section 4.5).

Clinical cases of hypothyroidism have been reported in thyroidectomy patients undergoing levothyroxine replacement during treatment with Glivec (see section 4.5). TSH levels should be closely monitored in such patients.

Metabolism of Glivec is mainly hepatic, and only 13% of excretion is through the kidneys. In patients with hepatic dysfunction (mild, moderate or severe), peripheral blood counts and liver enzymes should be carefully monitored (see sections 4.2, 4.8 and 5.2). It should be noted that GIST patients may have hepatic metastases which could lead to hepatic impairment.

Cases of liver injury, including hepatic failure and hepatic necrosis, have been observed with imatinib. When imatinib is combined with high dose chemotherapy regimens, an increase in serious hepatic reactions has been detected. Hepatic function should be carefully monitored in circumstances where imatinib is combined with chemotherapy regimens also known to be associated with hepatic dysfunction (see section 4.5 and 4.8).

Occurrences of severe fluid retention (pleural effusion, oedema, pulmonary oedema, ascites, superficial oedema) have been reported in approximately 2.5% of newly diagnosed CML patients taking Glivec. Therefore, it is highly recommended that patients be weighed regularly. An unexpected rapid weight gain should be carefully investigated and if necessary appropriate supportive care and therapeutic measures should be undertaken. In clinical trials, there was an increased incidence of these events in elderly patients and those with a prior history of cardiac disease. Therefore, caution should be exercised in patients with cardiac dysfunction.

Patients with cardiac disease or risk factors for cardiac failure should be monitored carefully, and any patient with signs or symptoms consistent with cardiac failure should be evaluated and treated.

In patients with hypereosinophilic syndrome (HES) and cardiac involvement, isolated cases of cardiogenic shock/left ventricular dysfunction have been associated with the initiation of imatinib therapy. The condition was reported to be reversible with the administration of systemic steroids, circulatory support measures and temporarily withholding imatinib. As cardiac adverse events have been reported uncommonly with imatinib, a careful assessment of the benefit/risk of imatinib therapy should be considered in the HES/CEL population before treatment initiation.

Myelodysplastic/myeloproliferative diseases with PDGFR gene re-arrangements could be associated with high eosinophil levels. Evaluation by a cardiology specialist, performance of an echocardiogram and determination of serum troponin should therefore be considered in patients with HES/CEL, and in patients with MDS/MPD associated with high eosinophil levels before imatinib is administered. If either is abnormal, follow-up with a cardiology specialist and the prophylactic use of systemic steroids (1–2 mg/kg) for one to two weeks concomitantly with imatinib should be considered at the initiation of therapy.

In the study in patients with unresectable and/or metastatic GIST, both gastrointestinal and intra-tumoural haemorrhages were reported (see section 4.8). Based on the available data, no predisposing factors (e.g. tumour size, tumour location, coagulation disorders) have been identified that place patients with GIST at a higher risk of either type of haemorrhage. Since increased vascularity and propensity for bleeding is a part of the nature and clinical course of GIST, standard practices and procedures for the monitoring and management of haemorrhage in all patients should be applied.

Laboratory tests

Complete blood counts must be performed regularly during therapy with Glivec. Treatment of CML patients with Glivec has been associated with neutropenia or thrombocytopenia. However, the occurrence of these cytopenias is likely to be related to the stage of the disease being treated and they were more frequent in patients with accelerated phase CML or blast crisis as compared to patients with chronic phase CML. Treatment with Glivec may be interrupted or the dose may be reduced, as recommended in section 4.2.

Liver function (transaminases, bilirubin, alkaline phosphatase) should be monitored regularly in patients receiving Glivec.

In patients with impaired renal function, imatinib plasma exposure seems to be higher than that in patients with normal renal function, probably due to an elevated plasma level of alpha-acid glycoprotein (AGP), an imatinib-binding protein, in these patients. Patients with renal impairment should be given the minimum starting dose. Patients with severe renal impairment should be treated with caution. The dose can be reduced if not tolerated (see section 4.2 and 5.2).

4.5 Interaction with other medicinal products and other forms of interaction

Active substances that may **increase** imatinib plasma concentrations:

Substances that inhibit the cytochrome P450 isoenzyme CYP3A4 activity (e.g. ketoconazole, itraconazole, erythromycin, clarithromycin) could decrease metabolism and increase imatinib concentrations. There was a significant increase in exposure to imatinib (the mean C_{max} and AUC of imatinib rose by 26% and 40%, respectively) in healthy subjects when it was co-administered with a single dose of ketoconazole (a CYP3A4 inhibitor). Caution should be taken when administering Glivec with inhibitors of the CYP3A4 family.

Active substances that may **decrease** imatinib plasma concentrations:

Substances that are inducers of CYP3A4 activity could increase metabolism and decrease imatinib plasma concentrations. Co-medications which induce CYP3A4 (e.g. dexamethasone, phenytoin, carbamazepine, rifampicin, phenobarbital, fosphenytoin, primidone or *Hypericum perforatum*, also known as St. John's Wort) may significantly reduce exposure to Glivec, potentially increasing the risk of therapeutic failure. Pretreatment with multiple doses of rifampicin 600 mg followed by a single 400 mg dose of Glivec resulted in decrease in C_{max} and AUC_(0-∞) by at least 54% and 74%, of the respective values without rifampicin treatment. Similar results were observed in patients with malignant gliomas treated with Glivec while taking enzyme-inducing anti-epileptic drugs (EIAEDs) such as carbamazepine, oxcarbazepine and phenytoin. The plasma AUC for imatinib decreased by 73% compared to patients not on EIAEDs. Concomitant use of rifampicin or other strong CYP3A4 inducers and imatinib should be avoided.

Active substances that may have their plasma concentration altered by Glivec

Imatinib increases the mean C_{max} and AUC of simvastatin (CYP3A4 substrate) 2- and 3.5-fold, respectively, indicating an inhibition of the CYP3A4 by imatinib. Therefore, caution is recommended when administering Glivec with CYP3A4 substrates with a narrow therapeutic window (e.g. cyclosporin or pimozide). Glivec may increase plasma concentration of other CYP3A4 metabolised drugs (e.g. triazolo-benzodiazepines, dihydropyridine calcium channel blockers, certain HMG-CoA reductase inhibitors, i.e. statins, etc.).

Because warfarin is metabolised by CYP2C9, patients who require anticoagulation should receive low-molecular-weight or standard heparin.

In vitro Glivec inhibits the cytochrome P450 isoenzyme CYP2D6 activity at concentrations similar to those that affect CYP3A4 activity. Imatinib at 400 mg twice daily had an inhibitory effect on CYP2D6-mediated metoprolol metabolism, with metoprolol C_{max} and AUC being increased by approximately 23% (90%CI [1.16-1.30]). Dose adjustments do not seem to be necessary when imatinib is co-administered with CYP2D6 substrates, however caution is advised for CYP2D6 substrates with a narrow therapeutic window such as metoprolol. In patients treated with metoprolol clinical monitoring should be considered.

In vitro, Glivec inhibits paracetamol O-glucuronidation (K_i value of 58.5 micromol/l at therapeutic levels).

Caution should therefore be exercised when using Glivec and paracetamol concomitantly, especially with high doses of paracetamol.

In thyroidectomy patients receiving levothyroxine, the plasma exposure to levothyroxine may be decreased when Glivec is co-administered (see section 4.4). Caution is therefore recommended. However, the mechanism of the observed interaction is presently unknown.

In Ph+ ALL patients, there is clinical experience of co-administering Glivec with chemotherapy (see section 5.1), but drug-drug interactions between imatinib and chemotherapy regimens are not well characterised. Imatinib adverse events, i.e. hepatotoxicity, myelosuppression or others, may increase and it has been reported that concomitant use with L-asparaginase could be associated with increased hepatotoxicity (see section 4.8). Therefore, the use of Glivec in combination requires special precaution.

4.6 Pregnancy and lactation

Pregnancy

There are no adequate data on the use of imatinib in pregnant women. Studies in animals have however shown reproductive toxicity (see section 5.3) and the potential risk for the foetus is unknown. Glivec should not be used during pregnancy unless clearly necessary. If it is used during pregnancy, the patient must be informed of the potential risk to the foetus. Women of childbearing potential must be advised to use effective contraception during treatment.

Lactation

There is limited information on imatinib distribution on human milk. Studies in two breast-feeding women revealed that both imatinib and its active metabolite can be distributed into human milk. The milk plasma ratio studied in a single patient was determined to be 0.5 for imatinib and 0.9 for the metabolite, suggesting greater distribution of the metabolite into the milk. Considering the combined concentration of imatinib and the metabolite and the maximum daily milk intake by infants, the total exposure would be expected to be low (~10% of a therapeutic dose). However, since the effects of low-dose exposure of the infant to imatinib are unknown, women taking imatinib should not breast-feed.

4.7 Effects on ability to drive and use machines

No studies on the effects on the ability to drive and use machines have been performed. However, patients should be advised that they may experience undesirable effects such as dizziness or blurred vision during treatment with imatinib. Therefore, caution should be recommended when driving a car or operating machinery.

4.8 Undesirable effects

Patients with advanced stages of malignancies may have numerous confounding medical conditions that make causality of adverse reactions difficult to assess due to the variety of symptoms related to the underlying disease, its progression, and the co-administration of numerous medicinal products.

In clinical trials in CML, drug discontinuation for drug-related adverse reactions was observed in 2.4% of newly diagnosed patients, 4% of patients in late chronic phase after failure of interferon therapy, 4% of patients in accelerated phase after failure of interferon therapy and 5% of blast crisis patients after failure of interferon therapy. In GIST the study drug was discontinued for drug-related adverse reactions in 4% of patients.

The adverse reactions were similar in all indications, with two exceptions. There was more myelosuppression seen in CML patients than in GIST, which is probably due to the underlying disease. In the study in patients with unresectable and/or metastatic GIST, 7 (5%) patients experienced CTC grade 3/4 GI bleeds (3 patients), intra-tumoural bleeds (3 patients) or both (1 patient). GI tumour sites may have been the source of the GI bleeds (see section 4.4). GI and tumoural bleeding may be serious and sometimes fatal. The most commonly reported ($\geq 10\%$) drug-related adverse reactions in both settings were mild nausea, vomiting, diarrhoea, abdominal pain, fatigue, myalgia, muscle cramps and rash. Superficial oedemas were a common finding in all studies and were described primarily as periorbital or lower limb oedemas. However, these oedemas were rarely severe and may be managed with diuretics, other supportive measures, or by reducing the dose of Glivec.

When imatinib was combined with high dose chemotherapy in Ph+ ALL patients, transient liver toxicity in the form of transaminase elevation and hyperbilirubinaemia were observed.

Miscellaneous adverse reactions such as pleural effusion, ascites, pulmonary oedema and rapid weight gain with or without superficial oedema may be collectively described as “fluid retention”. These reactions can usually be managed by withholding Glivec temporarily and with diuretics and other appropriate supportive care measures. However, some of these reactions may be serious or life-threatening and several patients with blast crisis died with a complex clinical history of pleural effusion, congestive heart failure and renal failure. There were no special safety findings in paediatric clinical trials.

Adverse reactions

Adverse reactions reported as more than an isolated case are listed below, by system organ class and by frequency. Frequencies are defined as: very common ($>1/10$), common ($>1/100, \leq 1/10$), uncommon ($>1/1,000, \leq 1/100$), rare ($\leq 1/1,000$), not known (cannot be estimated from the available data).

Within each frequency grouping, undesirable effects are presented in order of frequency, the most frequent first.

Adverse reactions and their frequencies reported in Table 1 are based on the main registration studies.

Table 1 Adverse reactions in clinical studies

Investigations	
<i>Very common:</i>	Weight increased
<i>Common:</i>	Weight decreased
<i>Uncommon:</i>	Blood creatinine increased, blood creatine phosphokinase increased, blood lactate dehydrogenase increased, blood alkaline phosphatase increased
<i>Rare:</i>	Blood amylase increased
Cardiac disorders	
<i>Uncommon:</i>	Palpitations, tachycardia, cardiac failure congestive ¹ , pulmonary oedema
<i>Rare:</i>	Arrhythmia, atrial fibrillation, cardiac arrest, myocardial infarction, angina pectoris, pericardial effusion

Blood and lymphatic system disorders	
<i>Very common:</i>	Neutropenia, thrombocytopenia, anaemia
<i>Common:</i>	Pancytopenia, febrile neutropenia
<i>Uncommon:</i>	Thrombocythaemia, lymphopenia, bone marrow depression, eosinophilia, lymphadenopathy
<i>Rare:</i>	Haemolytic anaemia
Nervous system disorders	
<i>Very common:</i>	Headache ²
<i>Common:</i>	Dizziness, paraesthesia, taste disturbance, hypoaesthesia
<i>Uncommon:</i>	Migraine, somnolence, syncope, peripheral neuropathy, memory impairment, sciatica, restless leg syndrome, tremor, cerebral haemorrhage
<i>Rare:</i>	Increased intracranial pressure, convulsions, optic neuritis
Eye disorders	
<i>Common:</i>	Eyelid oedema, lacrimation increased, conjunctival haemorrhage, conjunctivitis, dry eye, blurred vision
<i>Uncommon:</i>	Eye irritation, eye pain, orbital oedema, scleral haemorrhage, retinal haemorrhage, blepharitis, macular oedema
<i>Rare:</i>	Cataract, glaucoma, papilloedema
Ear and labyrinth disorders	
<i>Uncommon:</i>	Vertigo, tinnitus, hearing loss
Respiratory, thoracic and mediastinal disorders	
<i>Common:</i>	Dyspnoea, epistaxis, cough
<i>Uncommon:</i>	Pleural effusion ³ , pharyngolaryngeal pain, pharyngitis
<i>Rare:</i>	Pleuritic pain, pulmonary fibrosis, pulmonary hypertension, pulmonary haemorrhage
Gastrointestinal disorders	
<i>Very common:</i>	Nausea, diarrhoea, vomiting, dyspepsia, abdominal pain ⁴
<i>Common:</i>	Flatulence, abdominal distension, gastro-oesophageal reflux, constipation, dry mouth, gastritis
<i>Uncommon:</i>	Stomatitis, mouth ulceration, gastrointestinal haemorrhage ⁵ , eructation, melaena, oesophagitis, ascites, gastric ulcer, haematemesis, cheilitis, dysphagia, pancreatitis
<i>Rare:</i>	Colitis, ileus, inflammatory bowel disease
Renal and urinary disorders	
<i>Uncommon:</i>	Renal pain, haematuria, renal failure acute, urinary frequency increased
Skin and subcutaneous tissue disorders	
<i>Very common:</i>	Periorbital oedema, dermatitis/eczema/rash
<i>Common:</i>	Pruritus, face oedema, dry skin, erythema, alopecia, night sweats, photosensitivity reaction
<i>Uncommon:</i>	Rash pustular, contusion, sweating increased, urticaria, ecchymosis, increased tendency to bruise, hypotrichosis, skin hypopigmentation, dermatitis exfoliative, onychoclasia, folliculitis, petechiae, psoriasis, purpura, skin hyperpigmentation, bullous eruptions
<i>Rare:</i>	Acute febrile neutrophilic dermatosis (Sweet's syndrome), nail discolouration, angioneurotic oedema, rash vesicular, erythema multiforme, leucocytoclastic vasculitis, Stevens-Johnson syndrome, acute generalised exanthematous pustulosis (AGEP)
Musculoskeletal and connective tissue disorders	
<i>Very common:</i>	Muscle spasm and cramps, musculoskeletal pain including myalgia, arthralgia, bone pain ⁶
<i>Common:</i>	Joint swelling
<i>Uncommon:</i>	Joint and muscle stiffness
<i>Rare:</i>	Muscular weakness, arthritis, rhabdomyolysis/myopathy

Metabolism and nutrition disorders	
<i>Common:</i>	Anorexia
<i>Uncommon:</i>	Hypokalaemia, increased appetite, hypophosphataemia, decreased appetite, dehydration, gout, hyperuricaemia, hypercalcaemia, hyperglycaemia, hyponatraemia
<i>Rare:</i>	Hyperkalaemia, hypomagnesaemia
Infections and infestations	
<i>Uncommon:</i>	Herpes zoster, herpes simplex, nasopharyngitis, pneumonia ⁷ , sinusitis, cellulitis, upper respiratory tract infection, influenza, urinary tract infection, gastroenteritis, sepsis
<i>Rare:</i>	Fungal infection
Vascular disorders⁸	
<i>Common:</i>	Flushing, haemorrhage
<i>Uncommon:</i>	Hypertension, haematoma, peripheral coldness, hypotension, Raynaud's phenomenon
General disorders and administration site conditions	
<i>Very common:</i>	Fluid retention and oedema, fatigue
<i>Common:</i>	Weakness, pyrexia, anasarca, chills, rigors
<i>Uncommon:</i>	Chest pain, malaise
Hepatobiliary disorders	
<i>Common:</i>	Increased hepatic enzymes
<i>Uncommon:</i>	Hyperbilirubinaemia, hepatitis, jaundice
<i>Rare:</i>	Hepatic failure ⁹ , hepatic necrosis
Reproductive system and breast disorders	
<i>Uncommon:</i>	Gynaecomastia, erectile dysfunction, menorrhagia, menstruation irregular, sexual dysfunction, nipple pain, breast enlargement, scrotal oedema
<i>Rare:</i>	Haemorrhagic corpus luteum/haemorrhagic ovarian cyst
Psychiatric disorders	
<i>Common:</i>	Insomnia
<i>Uncommon:</i>	Depression, libido decreased, anxiety
<i>Rare:</i>	Confusional state

- 1 On a patient-year basis, cardiac events including congestive heart failure were more commonly observed in patients with transformed CML than in patients with chronic CML.
- 2 Headache was the most common in GIST patients.
- 3 Pleural effusion was reported more commonly in patients with GIST and in patients with transformed CML (CML-AP and CML-BC) than in patients with chronic CML.
- 4+5 Abdominal pain and gastrointestinal haemorrhage were most commonly observed in GIST patients.
- 6 Musculoskeletal pain and related events were more commonly observed in patients with CML than in GIST patients.
- 7 Pneumonia was reported most commonly in patients with transformed CML and in patients with GIST.
- 8 Flushing was most common in GIST patients and bleeding (haematoma, haemorrhage) was most common in patients with GIST and with transformed CML (CML-AP and CML-BC).
- 9 Some fatal cases of hepatic failure and of hepatic necrosis have been reported.

The following types of reactions have been reported mainly from post-marketing experience with Glivec. This includes spontaneous case reports as well as serious adverse events from ongoing studies, the expanded access programmes, clinical pharmacology studies and exploratory studies in unapproved indications. Because these reactions are reported from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to imatinib exposure.

Table 2 Adverse reactions from post-marketing reports

Neoplasm benign, malignant and unspecified (including cysts and polyps)	
<i>Not known:</i>	Tumour haemorrhage/tumour necrosis
Immune system disorders	
<i>Not known:</i>	Anaphylactic shock
Cardiac disorders	
<i>Not known:</i>	Pericarditis, cardiac tamponade
Nervous system disorders	
<i>Not known:</i>	Cerebral oedema
Eye disorders	
<i>Not known:</i>	Vitreous haemorrhage
Respiratory, thoracic and mediastinal disorders	
<i>Not known:</i>	Acute respiratory failure ¹ , interstitial lung disease
Gastrointestinal disorders	
<i>Not known:</i>	Ileus/intestinal obstruction, gastrointestinal perforation, diverticulitis
Skin and subcutaneous tissue disorders	
<i>Not known:</i>	Lichenoid keratosis, lichen planus
<i>Not known:</i>	Toxic epidermal necrolysis
Musculoskeletal and connective tissue disorders	
<i>Not known:</i>	Avascular necrosis/hip necrosis
Vascular disorders	
<i>Not known:</i>	Thrombosis/embolism

- 1 Fatal cases have been reported in patients with advanced disease, severe infections, severe neutropenia and other serious concomitant conditions.

Laboratory test abnormalities

Haematology

In CML, cytopenias, particularly neutropenia and thrombocytopenia, have been a consistent finding in all studies, with the suggestion of a higher frequency at high doses ≥ 750 mg (phase I study).

However, the occurrence of cytopenias was also clearly dependent on the stage of the disease, the frequency of grade 3 or 4 neutropenias ($ANC < 1.0 \times 10^9/l$) and thrombocytopenias (platelet count $< 50 \times 10^9/l$) being between 4 and 6 times higher in blast crisis and accelerated phase (59–64% and 44–63% for neutropenia and thrombocytopenia, respectively) as compared to newly diagnosed patients in chronic phase CML (16.7% neutropenia and 8.9% thrombocytopenia). In newly diagnosed chronic phase CML grade 4 neutropenia ($ANC < 0.5 \times 10^9/l$) and thrombocytopenia (platelet count $< 10 \times 10^9/l$) were observed in 3.6% and $< 1\%$ of patients, respectively. The median duration of the neutropenic and thrombocytopenic episodes usually ranged from 2 to 3 weeks, and from 3 to 4 weeks, respectively. These events can usually be managed with either a reduction of the dose or an interruption of treatment with Glivec, but can in rare cases lead to permanent discontinuation of treatment. In paediatric CML patients the most frequent toxicities observed were grade 3 or 4 cytopenias involving neutropenia, thrombocytopenia and anaemia. These generally occur within the first several months of therapy.

In the study in patients with unresectable and/or metastatic GIST, grade 3 and 4 anaemia was reported in 5.4% and 0.7% of patients, respectively, and may have been related to gastrointestinal or intra-tumoural bleeding in at least some of these patients. Grade 3 and 4 neutropenia was seen in 7.5% and 2.7% of patients, respectively, and grade 3 thrombocytopenia in 0.7% of patients. No patient developed grade 4 thrombocytopenia. The decreases in white blood cell (WBC) and neutrophil counts occurred mainly during the first six weeks of therapy, with values remaining relatively stable thereafter.

Biochemistry

Severe elevation of transaminases (<5%) or bilirubin (<1%) was seen in CML patients and was usually managed with dose reduction or interruption (the median duration of these episodes was approximately one week). Treatment was discontinued permanently because of liver laboratory abnormalities in less than 1% of CML patients. In GIST patients (study B2222), 6.8% of grade 3 or 4 ALT (alanine aminotransferase) elevations and 4.8% of grade 3 or 4 AST (aspartate aminotransferase) elevations were observed. Bilirubin elevation was below 3%.

There have been cases of cytolytic and cholestatic hepatitis and hepatic failure; in some of them outcome was fatal, including one patient on high dose paracetamol.

4.9 Overdose

Experience with doses higher than the recommended therapeutic dose is limited. Isolated cases of Glivec overdose have been reported spontaneously and in the literature. In the event of overdose the patient should be observed and appropriate symptomatic treatment given. Generally the reported outcome in these cases was “improved” or “recovered”. Events that have been reported at different dose ranges are as follows:

Adult overdose:

1200 to 1600 mg (duration varying between 1 to 10 days): Nausea, vomiting, diarrhoea, rash, erythema, oedema, swelling, fatigue, muscle spasms, thrombocytopenia, pancytopenia, abdominal pain, headache, decreased appetite.

1800 to 3200 mg (as high as 3200 mg daily for 6 days): Weakness, myalgia, increased creatine phosphokinase, increased bilirubin, gastrointestinal pain.

6400 mg (single dose): One case reported in the literature of one patient who experienced nausea, vomiting, abdominal pain, pyrexia, facial swelling, decreased neutrophil count, increased transaminases.

8 to 10 g (single dose): Vomiting and gastrointestinal pain have been reported.

Paediatric overdose:

One 3-year-old male exposed to a single dose of 400 mg experienced vomiting, diarrhoea and anorexia and another 3-year-old male exposed to a single dose of 980 mg dose experienced decreased white blood cell count and diarrhoea.

In the event of overdose, the patient should be observed and appropriate supportive treatment given.

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: protein-tyrosine kinase inhibitor, ATC code: L01XE01

Imatinib is a protein-tyrosine kinase inhibitor which potently inhibits the Bcr-Abl tyrosine kinase at the *in vitro*, cellular and *in vivo* levels. The compound selectively inhibits proliferation and induces apoptosis in Bcr-Abl positive cell lines as well as fresh leukaemic cells from Philadelphia chromosome positive CML and acute lymphoblastic leukaemia (ALL) patients.

In vivo the compound shows anti-tumour activity as a single agent in animal models using Bcr-Abl positive tumour cells.

Imatinib is also an inhibitor of the receptor tyrosine kinases for platelet-derived growth factor (PDGF), PDGF-R, and stem cell factor (SCF), c-Kit, and inhibits PDGF- and SCF-mediated cellular events. *In vitro*, imatinib inhibits proliferation and induces apoptosis in gastrointestinal stromal tumour (GIST) cells, which express an activating *kit* mutation. Constitutive activation of the PDGF receptor or the

Abl protein tyrosine kinases as a consequence of fusion to diverse partner proteins or constitutive production of PDGF have been implicated in the pathogenesis of MDS/MPD, HES/CEL and DFSP. Imatinib inhibits signalling and proliferation of cells driven by dysregulated PDGFR and Abl kinase activity.

Clinical studies in chronic myeloid leukaemia

The effectiveness of Glivec is based on overall haematological and cytogenetic response rates and progression-free survival. Except in newly diagnosed chronic phase CML, there are no controlled trials demonstrating a clinical benefit, such as improvement in disease-related symptoms or increased survival.

Three large, international, open-label, non-controlled phase II studies were conducted in patients with Philadelphia chromosome positive (Ph+) CML in advanced, blast or accelerated phase disease, other Ph+ leukaemias or with CML in the chronic phase but failing prior interferon-alpha (IFN) therapy. One large, open-label, multicentre, international randomised phase III study has been conducted in patients with newly diagnosed Ph+ CML. In addition, children have been treated in two phase I studies and one phase II study.

In all clinical studies 38–40% of patients were ≥ 60 years of age and 10–12% of patients were ≥ 70 years of age.

Chronic phase, newly diagnosed: This phase III study in adult patients compared treatment with either single-agent Glivec or a combination of interferon-alpha (IFN) plus cytarabine (Ara-C). Patients showing lack of response (lack of complete haematological response (CHR) at 6 months, increasing WBC, no major cytogenetic response (MCyR) at 24 months), loss of response (loss of CHR or MCyR) or severe intolerance to treatment were allowed to cross over to the alternative treatment arm. In the Glivec arm, patients were treated with 400 mg daily. In the IFN arm, patients were treated with a target dose of IFN of 5 MIU/m²/day subcutaneously in combination with subcutaneous Ara-C 20 mg/m²/day for 10 days/month.

A total of 1,106 patients were randomised, 553 to each arm. Baseline characteristics were well balanced between the two arms. Median age was 51 years (range 18–70 years), with 21.9% of patients ≥ 60 years of age. There were 59% males and 41% females; 89.9% caucasian and 4.7% black patients. Seven years after the last patient had been recruited, the median duration of first-line treatment was 82 and 8 months in the Glivec and IFN arms, respectively. The median duration of second-line treatment with Glivec was 64 months. Overall, in patients receiving first-line Glivec, the average daily dose delivered was 406 ± 76 mg. The primary efficacy endpoint of the study is progression-free survival. Progression was defined as any of the following events: progression to accelerated phase or blast crisis, death, loss of CHR or MCyR, or in patients not achieving a CHR an increasing WBC despite appropriate therapeutic management. Major cytogenetic response, haematological response, molecular response (evaluation of minimal residual disease), time to accelerated phase or blast crisis and survival are main secondary endpoints. Response data are shown in Table 3.

Table 3 Response in newly diagnosed CML Study (84-month data)

(Best response rates)	Glivec n=553	IFN+Ara-C n=553
Haematological response		
CHR rate n (%) [95% CI]	534 (96.6%)* [94.7%, 97.9%]	313 (56.6%)* [52.4%, 60.8%]
Cytogenetic response		
Major response n (%) [95% CI]	490 (88.6%)* [85.7%, 91.1%]	129 (23.3%)* [19.9%, 27.1%]
Complete CyR n (%)	456 (82.5%)*	64 (11.6%)*
Partial CyR n (%)	34 (6.1%)	65 (11.8%)
Molecular response**		
Major response at 12 months (%)	153/305=50.2%	8/83=9.6%
Major response at 24 months (%)	73/104=70.2%	3/12=25%
Major response at 84 months (%)	102/116=87.9%	3/4=75%
* p<0.001, Fischer's exact test		
** molecular response percentages are based on available samples		
Haematological response criteria (all responses to be confirmed after ≥ 4 weeks): WBC < 10 x 10 ⁹ /l, platelet < 450 x 10 ⁹ /l, myelocyte+metamyelocyte < 5% in blood, no blasts and promyelocytes in blood, basophils < 20%, no extramedullary involvement		
Cytogenetic response criteria: complete (0% Ph+ metaphases), partial (1–35%), minor (36–65%) or minimal (66–95%). A major response (0–35%) combines both complete and partial responses.		
Major molecular response criteria: in the peripheral blood reduction of ≥ 3 logarithms in the amount of Bcr-Abl transcripts (measured by real-time quantitative reverse transcriptase PCR assay) over a standardised baseline.		

Rates of complete haematological response, major cytogenetic response and complete cytogenetic response on first-line treatment were estimated using the Kaplan-Meier approach, for which non-responses were censored at the date of last examination. Using this approach, the estimated cumulative response rates for first-line treatment with Glivec improved from 12 months of therapy to 84 months of therapy as follows: CHR from 96.4% to 98.4% and CCyR from 69.5% to 87.2%, respectively.

With 7 years follow-up, there were 93 (16.8%) progression events in the Glivec arm: 37 (6.7%) involving progression to accelerated phase/blast crisis, 31 (5.6%) loss of MCyR, 15 (2.7%) loss of CHR or increase in WBC, and 10 (1.8%) CML unrelated deaths. In contrast, there were 165 (29.8%) events in the IFN+Ara-C arm, of which 130 occurred during first-line treatment with IFN+Ara-C.

The estimated rate of patients free of progression to accelerated phase or blast crisis at 84 months was significantly higher in the Glivec arm compared to the IFN arm (92.5% versus 85.1%, p<0.001). The annual rate of progression to accelerated phase or blast crisis decreased with time on therapy and was less than 1% annually in the fourth and fifth years. The estimated rate of progression-free survival at 84 months was 81.2% in the Glivec arm and 60.6% in the control arm (p<0.001). The yearly rates of progression of any type for Glivec also decreased over time.

A total of 71 (12.8%) and 85 (15.4%) patients died in the Glivec and IFN+Ara-C groups, respectively. At 84 months the estimated overall survival is 86.4% (83, 90) vs. 83.3% (80, 87) in the randomised Glivec and the IFN+Ara-C groups, respectively (p=0.073, log-rank test). This time-to-event endpoint is strongly affected by the high crossover rate from IFN+Ara-C to Glivec. The effect of Glivec treatment on survival in chronic phase, newly diagnosed CML has been further examined in a retrospective analysis of the above reported Glivec data with the primary data from another Phase III study using IFN+Ara-C (n=325) in an identical regimen. In this retrospective analysis, the superiority

of Glivec over IFN+Ara-C in overall survival was demonstrated ($p<0.001$); within 42 months, 47 (8.5%) Glivec patients and 63 (19.4%) IFN+Ara-C patients had died.

The degree of cytogenetic response and molecular response had a clear effect on long-term outcomes in patients on Glivec. Whereas an estimated 96% (93%) of patients with CCyR (PCyR) at 12 months were free of progression to accelerated phase/blast crisis at 84 months, only 81% of patients without MCyR at 12 months were free of progression to advanced CML at 84 months ($p<0.001$ overall, $p=0.25$ between CCyR and PCyR). For patients with reduction in Bcr-Abl transcripts of at least 3 logarithms at 12 months, the probability of remaining free from progression to accelerated phase/blast crisis was 99% at 84 months. Similar findings were found based on a 18-months landmark analysis.

In this study, dose escalations were allowed from 400 mg daily to 600 mg daily, then from 600 mg daily to 800 mg daily. After 42 months of follow-up, 11 patients experienced a confirmed loss (within 4 weeks) of their cytogenetic response. Of these 11 patients, 4 patients escalated up to 800 mg daily, 2 of whom regained a cytogenetic response (1 partial and 1 complete, the latter also achieving a molecular response), while of the 7 patients who did not escalate the dose, only one regained a complete cytogenetic response. The percentage of some adverse reactions was higher in the 40 patients in whom the dose was increased to 800 mg daily compared to the population of patients before dose increase ($n=551$). The more frequent adverse reactions included gastrointestinal haemorrhages, conjunctivitis and elevation of transaminases or bilirubin. Other adverse reactions were reported with lower or equal frequency.

Chronic phase, Interferon failure: 532 adult patients were treated at a starting dose of 400 mg. The patients were distributed in three main categories: haematological failure (29%), cytogenetic failure (35%), or intolerance to interferon (36%). Patients had received a median of 14 months of prior IFN therapy at doses $\geq 25 \times 10^6$ IU/week and were all in late chronic phase, with a median time from diagnosis of 32 months. The primary efficacy variable of the study was the rate of major cytogenetic response (complete plus partial response, 0 to 35% Ph⁺ metaphases in the bone marrow).

In this study 65% of the patients achieved a major cytogenetic response that was complete in 53% (confirmed 43%) of patients (Table 4). A complete haematological response was achieved in 95% of patients.

Accelerated phase: 235 adult patients with accelerated phase disease were enrolled. The first 77 patients were started at 400 mg, the protocol was subsequently amended to allow higher dosing and the remaining 158 patients were started at 600 mg.

The primary efficacy variable was the rate of haematological response, reported as either complete haematological response, no evidence of leukaemia (i.e. clearance of blasts from the marrow and the blood, but without a full peripheral blood recovery as for complete responses), or return to chronic phase CML. A confirmed haematological response was achieved in 71.5% of patients (Table 4). Importantly, 27.7% of patients also achieved a major cytogenetic response, which was complete in 20.4% (confirmed 16%) of patients. For the patients treated at 600 mg, the current estimates for median progression-free-survival and overall survival were 22.9 and 42.5 months, respectively.

Myeloid blast crisis: 260 patients with myeloid blast crisis were enrolled. 95 (37%) had received prior chemotherapy for treatment of either accelerated phase or blast crisis (“pretreated patients”) whereas 165 (63%) had not (“untreated patients”). The first 37 patients were started at 400 mg, the protocol was subsequently amended to allow higher dosing and the remaining 223 patients were started at 600 mg.

The primary efficacy variable was the rate of haematological response, reported as either complete haematological response, no evidence of leukaemia, or return to chronic phase CML using the same criteria as for the study in accelerated phase. In this study, 31% of patients achieved a haematological response (36% in previously untreated patients and 22% in previously treated patients). The rate of response was also higher in the patients treated at 600 mg (33%) as compared to the patients treated at

400 mg (16%, p=0.0220). The current estimate of the median survival of the previously untreated and treated patients was 7.7 and 4.7 months, respectively.

Lymphoid blast crisis: a limited number of patients were enrolled in phase I studies (n=10). The rate of haematological response was 70% with a duration of 2–3 months.

Table 4 Response in adult CML studies

	Study 0110 37-month data Chronic phase, IFN failure (n=532)	Study 0109 40.5-month data Accelerated phase (n=235)	Study 0102 38-month data Myeloid blast crisis (n=260)
	% of patients (CI _{95%})		
Haematological response ¹	95% (92.3–96.3)	71% (65.3–77.2)	31% (25.2–36.8)
Complete haematological response (CHR)	95%	42%	8%
No evidence of leukaemia (NEL)	Not applicable	12%	5%
Return to chronic phase (RTC)	Not applicable	17%	18%
Major cytogenetic response ²	65% (61.2–69.5)	28% (22.0–33.9)	15% (11.2–20.4)
Complete (Confirmed ³) [95% CI]	53% (43%) [38.6–47.2]	20% (16%) [11.3–21.0]	7% (2%) [0.6–4.4]
Partial	12%	7%	8%
<p>¹ Haematological response criteria (all responses to be confirmed after ≥ 4 weeks): CHR: Study 0110 [WBC < 10 x 10⁹/l, platelets < 450 x 10⁹/l, myelocyte+metamyelocyte < 5% in blood, no blasts and promyelocytes in blood, basophils < 20%, no extramedullary involvement] and in studies 0102 and 0109 [ANC ≥ 1.5 x 10⁹/l, platelets ≥ 100 x 10⁹/l, no blood blasts, BM blasts < 5% and no extramedullary disease] NEL Same criteria as for CHR but ANC ≥ 1 x 10⁹/l and platelets ≥ 20 x 10⁹/l (0102 and 0109 only) RTC < 15% blasts BM and PB, < 30% blasts+promyelocytes in BM and PB, < 20% basophils in PB, no extramedullary disease other than spleen and liver (only for 0102 and 0109). BM = bone marrow, PB = peripheral blood</p> <p>² Cytogenetic response criteria: A major response combines both complete and partial responses: complete (0% Ph+ metaphases), partial (1–35%)</p> <p>³ Complete cytogenetic response confirmed by a second bone marrow cytogenetic evaluation performed at least one month after the initial bone marrow study.</p>			

Paediatric patients: A total of 26 paediatric patients of age < 18 years with either chronic phase CML (n=11) or CML in blast crisis or Ph+ acute leukaemias (n=15) were enrolled in a dose-escalation phase I trial. This was a population of heavily pretreated patients, as 46% had received prior BMT and 73% a prior multi-agent chemotherapy. Patients were treated at doses of Glivec of 260 mg/m²/day (n=5), 340 mg/m²/day (n=9), 440 mg/m²/day (n=7) and 570 mg/m²/day (n=5). Out of 9 patients with chronic phase CML and cytogenetic data available, 4 (44%) and 3 (33%) achieved a complete and partial cytogenetic response, respectively, for a rate of MCyR of 77%.

A total of 51 paediatric patients with newly diagnosed and untreated CML in chronic phase have been enrolled in an open-label, multicentre, single-arm phase II trial. Patients were treated with Glivec 340 mg/m²/day, with no interruptions in the absence of dose limiting toxicity. Glivec treatment induces a rapid response in newly diagnosed paediatric CML patients with a CHR of 78% after 8 weeks of therapy. The high rate of CHR is accompanied by the development of a complete cytogenetic response (CCyR) of 65% which is comparable to the results observed in adults.

Additionally, partial cytogenetic response (PCyR) was observed in 16% for a MCyR of 81%. The majority of patients who achieved a CCyR developed the CCyR between months 3 and 10 with a median time to response based on the Kaplan-Meier estimate of 5.6 months.

Clinical studies in Ph+ ALL

Newly diagnosed Ph+ ALL: In a controlled study (ADE10) of imatinib versus chemotherapy induction in 55 newly diagnosed patients aged 55 years and over, imatinib used as single agent induced a significantly higher rate of complete haematological response than chemotherapy (96.3% vs. 50%; $p=0.0001$). When salvage therapy with imatinib was administered in patients who did not respond or who responded poorly to chemotherapy, it resulted in 9 patients (81.8%) out of 11 achieving a complete haematological response. This clinical effect was associated with a higher reduction in bcr-abl transcripts in the imatinib-treated patients than in the chemotherapy arm after 2 weeks of therapy ($p=0.02$). All patients received imatinib and consolidation chemotherapy (see Table 5) after induction and the levels of bcr-abl transcripts were identical in the two arms at 8 weeks. As expected on the basis of the study design, no difference was observed in remission duration, disease-free survival or overall survival, although patients with complete molecular response and remaining in minimal residual disease had a better outcome in terms of both remission duration ($p=0.01$) and disease-free survival ($p=0.02$).

The results observed in a population of 211 newly diagnosed Ph+ ALL patients in four uncontrolled clinical studies (AAU02, ADE04, AJP01 and AUS01) are consistent with the results described above. Imatinib in combination with chemotherapy induction (see Table 5) resulted in a complete haematological response rate of 93% (147 out of 158 evaluable patients) and in a major cytogenetic response rate of 90% (19 out of 21 evaluable patients). The complete molecular response rate was 48% (49 out of 102 evaluable patients). Disease-free survival (DFS) and overall survival (OS) constantly exceeded 1 year and were superior to historical control (DFS $p<0.001$; OS $p<0.0001$) in two studies (AJP01 and AUS01).

Table 5 Chemotherapy regimen used in combination with imatinib

Study ADE10	
Prephase	DEX 10 mg/m ² oral, days 1-5; CP 200 mg/m ² i.v., days 3, 4, 5; MTX 12 mg intrathecal, day 1
Remission induction	DEX 10 mg/m ² oral, days 6-7, 13-16; VCR 1 mg i.v., days 7, 14; IDA 8 mg/m ² i.v. (0.5 h), days 7, 8, 14, 15; CP 500 mg/m ² i.v. (1 h) day 1; Ara-C 60 mg/m ² i.v., days 22-25, 29-32
Consolidation therapy I, III, V	MTX 500 mg/m ² i.v. (24 h), days 1, 15; 6-MP 25 mg/m ² oral, days 1-20
Consolidation therapy II, IV	Ara-C 75 mg/m ² i.v. (1 h), days 1-5; VM26 60 mg/m ² i.v. (1 h), days 1-5
Study AAU02	
Induction therapy (<i>de novo</i> Ph+ ALL)	Daunorubicin 30 mg/m ² i.v., days 1-3, 15-16; VCR 2 mg total dose i.v., days 1, 8, 15, 22; CP 750 mg/m ² i.v., days 1, 8; prednisone 60 mg/m ² oral, days 1-7, 15-21; IDA 9 mg/m ² oral, days 1-28; MTX 15 mg intrathecal, days 1, 8, 15, 22; Ara-C 40 mg intrathecal, days 1, 8, 15, 22; methylprednisolone 40 mg intrathecal, days 1, 8, 15, 22
Consolidation (<i>de novo</i> Ph+ ALL)	Ara-C 1,000 mg/m ² /12 h i.v. (3 h), days 1-4; mitoxantrone 10 mg/m ² i.v. days 3-5; MTX 15 mg intrathecal, day 1; methylprednisolone 40 mg intrathecal, day 1

