Evolving assessments of molecular response in CML:
An overview of the GLEEVEC and second-generation TKI pivotal trials

The information herein is not presented to compare the efficacy or safety profile among the discussed second-generation TKIs. No implication of superiority or inferiority is intended or should be inferred.

TKI, tyrosine kinase inhibitor.

GLEEVEC® (imatinib mesylate) tablets are indicated for:

- Newly diagnosed adult and pediatric patients with Philadelphia chromosome–positive chronic myeloid leukemia (Ph+ CML) in the chronic phase
- Patients with Ph+ CML in blast crisis (BC), accelerated phase (AP), or in chronic phase (CP) after failure of interferon-alpha therapy

IMPORTANT SAFETY INFORMATION

- GLEEVEC is often associated with edema and, occasionally, serious fluid retention. Severe fluid retention was reported in 9% to 13.1% and 2.5% to 11% of patients taking GLEEVEC for GIST and CML, respectively. Patients should be weighed and monitored regularly for signs and symptoms of fluid retention, which can be serious or life threatening, and be advised to report any rapid, unexpected weight gain. The probability of edema tended to be increased among older patients (>65 years) or those taking higher doses of GLEEVEC. Severe edema and superficial edema were observed in 182 (11.1%) GIST patients and 1.5% to 6% in CML patients, respectively. If severe fluid retention occurs, manage with diuretic therapy and withhold GLEEVEC until the event has resolved, and then resume, depending on the initial severity of the event. In a study of patients with newly diagnosed Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, severe (grade 3 or 4) fluid retention occurred in 2.5% of patients receiving GLEEVEC and in 3.9% of patients receiving nilotinib. Effusions or pulmonary edema were observed in 2.1% (none were grade 3 or 4) of patients in the GLEEVEC arm and 2.2% (0.7% grade 3 or 4) of patients in the nilotinib arm

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Clinical trial end points and molecular milestones have evolved since the approval of GLEEVEC in 2001\(^1\)-\(^4\)

Molecular response measures have deepened in clinical trials and community practice, establishing new treatment milestones\(^1\)-\(^4\):

- Imatinib mesylate (GLEEVEC\(^\circ\)) tablets approval in 2001 shifted the CML treatment paradigm and, with subsequent trials, established TKIs as standard of care\(^5\)-\(^6\).
- The GLEEVEC pivotal trial measured CHR and MCyR (complete or partial) as secondary end points\(^1\).
- More recent clinical trials use CCyR and MMR as primary end points to assess response\(^2\)-\(^4\).
- With advancements in the assay sensitivity, milestones for molecular response have also evolved and response measurement continues to deepen\(^6\)-\(^7\).

**Measuring Response to Therapy in Ph+ CML\(^6\)-\(^7\)**

<table>
<thead>
<tr>
<th>Proportion of BCR-ABL1 (%)</th>
<th>CHR</th>
<th>CCyR</th>
<th>MMR</th>
<th>DMR (MR4.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td></td>
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<td></td>
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<tr>
<td>1%</td>
<td></td>
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<td>0.1%</td>
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<tr>
<td>0.01%</td>
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<td></td>
<td></td>
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<tr>
<td>0.0032%</td>
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</tbody>
</table>


Ongoing research with TKI therapy has confirmed the prognostic importance of earlier molecular responses and established EMR as a standard milestone\(^8\)-\(^9\):

- IRIS was the first randomized trial to demonstrate that monitoring BCR-ABL1 transcript levels throughout therapy with real-time PCR had prognostic value\(^8\).

In an independent retrospective analysis by Marin et al of 282 patients with CML-CP treated with frontline GLEEVEC, followed by either nilotinib or dasatinib upon treatment failure, results demonstrated\(^10\):

- Patients with BCR-ABL1 transcript levels <9.84% at 3 months had significantly better 8-year OS compared with those who did not achieve an early response (93.3% of 211 patients versus 56.9% of 68 patients).
- While BCR-ABL1 transcript levels at 3, 6, and 12 months all strongly predicted relevant clinical outcomes, such as likelihood of achieving MMR, EMR at 3 months was the only independent predictor for improved overall survival in CML.

Measuring response at 3 months is the most accurate method to assess long-term prognosis and allows for earlier clinical intervention\(^10\).

**IMPORTANT SAFETY INFORMATION** (cont)

- Cytopenias have been reported. Complete blood counts should be performed weekly for the first month, biweekly for the second month, and periodically thereafter as clinically indicated (eg, every 2-3 months). Dose reduction, treatment interruption, or in rare cases discontinuation of treatment may be required for severe neutropenia or thrombocytopenia (see full Prescribing Information for dose adjustment recommendations).

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Current CML treatment goals focus on preventing disease progression to AP/BC with sustained molecular responses.\textsuperscript{11,12}

Guidelines reflect the importance of both preventing disease progression and attaining deep molecular responses, based on the results of more recent clinical trials.

The goal of TKI therapy is to achieve a CCyR (≤1% BCR-ABL1 IS) within 12 months of initiation of therapy and to prevent disease progression to AP/BC.\textsuperscript{5}

TKI selection should be based on treatment goals and comorbidities; chance to achieve DMR (MR4 or MR4.5).\textsuperscript{11}

Second-generation TKIs have been built on the foundation of GLEEVEC.

GLEEVEC\textsuperscript{©} (imatinib mesylate) tablets has served as the standard comparator for agents in development, and the study designs of the TKI pivotal trials below reflect the evolving goals and expectations of molecular response.

The following pivotal clinical trials in the newly diagnosed setting are included in this piece:

- **IRIS**
  - International Randomized Study of Interferon and Imatinib

- **ENESTnd**
  - A Phase 3, Multicenter, Open-label Study of Imatinib vs Nilotinib in Adult Patients With Newly Diagnosed Ph+ CML in Chronic Phase

- **DASISION**
  - An Open-Label, Randomized, Multicenter Phase 3 Trial of Dasatinib vs Imatinib in the Treatment of Subjects With Newly Diagnosed Chronic Phase Ph+ CML

- **BFORE**
  - A Multicenter Phase 3, Open-Label Study of Bosutinib vs Imatinib in Adult Patients With Newly Diagnosed Chronic Phase Chronic Myelogenous Leukemia

Congestive heart failure and left ventricular dysfunction (LVD) have been reported. Most patients with reported cardiac events have had other comorbidities and risk factors, including advanced age and previous medical history of cardiac disease. In a phase 3 study of patients with newly diagnosed Ph+ CML in chronic phase, severe cardiac failure and LVD occurred in 0.7% of GLEEVEC patients vs 0.9% of IFN+Ara-C patients. In a study of newly diagnosed Ph+ CML patients in chronic phase comparing GLEEVEC and nilotinib, cardiac failure was observed in 1.1% and 2.2% of patients, respectively, and severe (grade 3 or 4) cardiac failure occurred in 0.7% of patients in each group. Patients with cardiac disease, risk factors for cardiac disease, or history of renal failure should be monitored carefully, and any patient with signs or symptoms consistent with cardiac or renal failure should be evaluated and treated.
GLEEVEC has served as the comparator across the pivotal trials for second-generation TKIs

- The EPIC (ponatinib) study was terminated and not included in this review.¹²
- The differences in the primary end points reflect evolution of treatment goals and levels of response measures over the last 2 decades.⁶,⁷

### Study Design

#### IRIS: GLEEVEC® (imatinib mesylate) tablets vs IFN¹,¹³

- **Randomization**: Multinational, open-label, Phase 3 trial. Patients were stratified according to Hasford risk score. Treatment interruptions or dose reductions or escalations were allowed in each arm.³
- **Primary End Point**: Progression; OS (long-term)
- **Planned Study Follow-up**: 5.25 years
- **Total Study Follow-up**: 11 years

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLEEVEC 400 mg qd (n=553)</td>
<td>interferon alfa was gradually dosed until maximal tolerated dose was achieved, then low-dose cytarabine was added. Patients in both arms were permitted to receive hydroxyurea for the first 6 months.¹</td>
</tr>
<tr>
<td>IFN-α (target dose 5 mil U/m² of BSA/day) + cytarabine (n=553)</td>
<td></td>
</tr>
</tbody>
</table>

#### DASISION: Dasatinib vs GLEEVEC³,¹⁵

- **Randomization**: Ongoing, multinational, Phase 3 trial. Patients were stratified according to Sokal risk score and geographic region. Up to 2 sequential dose escalations were permitted for suboptimal response.⁴
- **Primary End Point**: Confirmed CCyR by 12 months
- **Study Follow-up**: 5 years

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAS 100 mg qd (n=259)</td>
<td></td>
</tr>
<tr>
<td>GLEEVEC 400 mg qd (n=260)</td>
<td></td>
</tr>
</tbody>
</table>

#### ENESTnd: Nilotinib vs GLEEVEC²,¹⁴

- **Randomization**: Multicenter, open-label, Phase 3 trial. Daily dose of GLEEVEC could be escalated to 800 mg (400 mg bid), but no dose escalation of nilotinib was permitted.⁷
- **Primary End Point**: MMR at 12 months (≥3 logs below standard established baseline)
- **Planned Study Follow-up**: 5 years
- **Extended Study Follow-up**: 10 years

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIL 300 mg bid (n=282)</td>
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</tr>
<tr>
<td>GLEEVEC 400 mg qd (n=283)</td>
<td></td>
</tr>
</tbody>
</table>

#### BFORE: Bosutinib vs GLEEVEC⁴

- **Randomization**: Ongoing, multinational, Phase 3 trial. Patients were stratified according to Sokal risk score and geographic region. Up to 2 sequential dose escalations were permitted for suboptimal response.⁴
- **Primary End Point**: MMR at 12 months
- **Planned Study Follow-up**: 5 years (not complete)

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOS 400 mg qd (n=268)</td>
<td></td>
</tr>
<tr>
<td>GLEEVEC 400 mg qd (n=268)</td>
<td></td>
</tr>
</tbody>
</table>

### IMPORTANT SAFETY INFORMATION (cont)

- Hepatotoxicity, occasionally severe, may occur. Cases of fatal liver failure and severe liver injury requiring liver transplants have been reported with both short-term and long-term use of GLEEVEC. Assess liver function before initiation of treatment and monthly thereafter, or as clinically indicated. A 25% decrease in the recommended dose should be used for patients with severe hepatic impairment. If severe hepatotoxicity occurs, GLEEVEC should be withheld until the event has resolved and then resumed, depending on the initial severity of the event.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Overview of patient demographics in TKI pivotal trials

**IRIS**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>GLEEVEC® (imatinib mesylate) tablets (n=553)</th>
<th>Interferon (n=553)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Age (years)</td>
<td>50</td>
<td>51</td>
</tr>
<tr>
<td>Sex % (n)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>61.7% (341)</td>
<td>56.1% (310)</td>
</tr>
<tr>
<td></td>
<td>38.3% (212)</td>
<td>43.9% (243)</td>
</tr>
<tr>
<td>Sokal Risk Assessment % (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>52.5% (201)</td>
<td>48.2% (190)</td>
</tr>
<tr>
<td>Inter. Risk</td>
<td>29.0% (111)</td>
<td>29.7% (117)</td>
</tr>
<tr>
<td>High Risk</td>
<td>18.5% (71)</td>
<td>22.1% (87)</td>
</tr>
</tbody>
</table>

**DASISION**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Dasatinib (n=259)</th>
<th>GLEEVEC (n=260)</th>
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</thead>
<tbody>
<tr>
<td>Median Age (years)</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>Sex % (n)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>56% (144)</td>
<td>63% (163)</td>
</tr>
<tr>
<td></td>
<td>44% (115)</td>
<td>37% (97)</td>
</tr>
<tr>
<td>Hasford Risk Assessment % (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>33% (86)</td>
<td>33% (87)</td>
</tr>
<tr>
<td>Inter. Risk</td>
<td>48% (124)</td>
<td>47% (123)</td>
</tr>
<tr>
<td>High Risk</td>
<td>19% (49)</td>
<td>19% (50)</td>
</tr>
</tbody>
</table>

**ENESTnd**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Nilotinib (n=282)</th>
<th>GLEEVEC (n=283)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Age (years)</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td>Sex % (n)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>56% (158)</td>
<td>56% (158)</td>
</tr>
<tr>
<td></td>
<td>44% (124)</td>
<td>44% (125)</td>
</tr>
<tr>
<td>Sokal Risk Assessment % (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>37% (103)</td>
<td>37% (104)</td>
</tr>
<tr>
<td>Inter. Risk</td>
<td>36% (101)</td>
<td>36% (101)</td>
</tr>
<tr>
<td>High Risk</td>
<td>28% (78)</td>
<td>28% (78)</td>
</tr>
</tbody>
</table>

**BFORE**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Bosutinib (n=246)</th>
<th>GLEEVEC (n=241)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Age (years)</td>
<td>52</td>
<td>53</td>
</tr>
<tr>
<td>Sex % (n)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>57.7% (142)</td>
<td>44% (106)</td>
</tr>
<tr>
<td></td>
<td>42.3% (104)</td>
<td>44% (106)</td>
</tr>
<tr>
<td>Sokal Risk Assessment % (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>38.2% (94)</td>
<td>39.4% (95)</td>
</tr>
<tr>
<td>Inter. Risk</td>
<td>41.5% (101)</td>
<td>39.4% (95)</td>
</tr>
<tr>
<td>High Risk</td>
<td>20.7% (51)</td>
<td>21.2% (51)</td>
</tr>
</tbody>
</table>

**IMPORTANT SAFETY INFORMATION (cont)**

- In the newly diagnosed CML trial of GLEEVEC vs IFN+Ara-C, 1.8% of patients had grade 3/4 hemorrhage. In a study with newly diagnosed Ph+ CML patients in the chronic phase comparing GLEEVEC and nilotinib, GI hemorrhage occurred in 1.4% and 2.9% of patients, respectively. None of these events were grade 3 or 4 in the GLEEVEC arm; 0.7% were grade 3 or 4 in the nilotinib arm.
- GLEEVEC is sometimes associated with GI irritation. There have been rare reports, including fatalities, of GI perforation.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Primary end points differ, reflecting the evolution of treatment goals and depth of response measures

IRIS established imatinib mesylate (GLEEVEC®) tablets as standard of care in CML, as well as the standard comparator against which second-generation TKIs are measured. ENESTnd was the first TKI pivotal trial to assess MMR as the primary end point, establishing evolved standards for molecular response.

**IRIS: Progression-free survival at 12 months**

Progression defined as: death from any cause during treatment; development of CML-AP; development of CML-BC; loss of CHR; loss of MCyR; or increasing white blood cell count.

**Molecular milestone for ENESTnd primary end point**

**Molecular milestone for DASISION primary end point**

**IMPORTANT SAFETY INFORMATION (cont)**

- Clinical cases of hypothyroidism have been reported in thyroidectomy patients undergoing levothyroxine replacement during treatment with GLEEVEC. TSH levels should be closely monitored in such patients.
- Fetal harm can occur when administered to a pregnant woman. Test pregnancy status in females of reproductive potential prior to GLEEVEC initiation. Advise sexually active females of reproductive potential to avoid pregnancy and use effective contraception (methods that result in <1% pregnancy rates) when taking GLEEVEC and for 14 days after stopping GLEEVEC. Advise women to avoid breastfeeding during treatment and for 1 month after the last dose because of the potential for serious adverse reactions in breastfed infants. If pregnancy occurs while taking GLEEVEC, apprise the patient of the potential hazard to the fetus.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
EMR is an important prognostic indicator of long-term outcomes in patients with CML

Measuring EMR is recognized as an important strategy to assess current patient progress, as well as likelihood of achieving a deeper molecular response and, ultimately, improving survival. The IRIS study did not proactively assess response at 3 months; however, BCR-ABL1 levels were assessed retrospectively at 3-month, 6-month, and 12-month timepoints in the subset of patients from the ITT population with available PCR samples.8

EMR was analyzed in the complete molecular monitoring dataset to demonstrate the long-term prognostic value of the levels of molecular response at specific time points. Patients enrolled in the imatinib arm of the IRIS trial with at least 1 BCR-ABL1 transcript measurement were included.

IRIS: CCyR at 3 months4

**BCR-ABL1 ≤1% (CCyR)**

![Graph showing IRIS CCyR at 3 months](image)

- **GLEEVEC® (imatinib mesylate) tablets (n=476)**
  - 10.7%

**IMPORTANT SAFETY INFORMATION (cont)**

- Growth retardation has been reported in children and preadolescents receiving GLEEVEC. The long-term effects of prolonged treatment with GLEEVEC on growth in children are unknown; therefore, monitoring of growth in children taking GLEEVEC is recommended.
- Cases of tumor lysis syndrome (TLS), including fatal cases, have been reported. The patients at risk for TLS are those with tumors having a high proliferative rate or high tumor burden prior to treatment. These patients should be monitored closely and appropriate precautions taken. Correction of clinically significant dehydration and treatment of high uric acid levels are recommended prior to initiation of GLEEVEC.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.

## Descriptive Analysis

### Early Response

**ENESTnd: EMR 3-month analysis**3

- **BCR-ABL1 ≤1% (CCyR)**
  - **GLEEVEC® (imatinib mesylate) tablets (n=234)**
    - 56%
  - **Nilotinib (n=259)**
    - 16%
  - **Dasatinib (n=246)**
    - 54%

- **BCR-ABL1 ≤10%**
  - **GLEEVEC® (imatinib mesylate) tablets (n=176)**
    - 91%
  - **Nilotinib (n=234)**
    - 67%
  - **Dasatinib (n=259)**
    - 84%

### DASISION: EMR 3-month analysis

- **BCR-ABL1 ≤1% (CCyR)**
  - **GLEEVEC® (imatinib mesylate) tablets (n=260)**
    - 54%
  - **Nilotinib (n=234)**
    - 31%
  - **Dasatinib (n=259)**
    - 23%

- **BCR-ABL1 ≤10%**
  - **GLEEVEC® (imatinib mesylate) tablets (n=260)**
    - 84%
  - **Nilotinib (n=234)**
    - 64%
  - **Dasatinib (n=259)**
    - 67%

### BFORE: EMR 3-month analysis4

- **BCR-ABL1 ≤1% (CCyR)**
  - **Bosutinib (n=246)**
    - 75%
  - **GLEEVEC® (imatinib mesylate) tablets (n=241)**
    - 57%

- **BCR-ABL1 ≤10%**
  - **Bosutinib (n=246)**
    - 18%
  - **GLEEVEC® (imatinib mesylate) tablets (n=241)**
    - 18%
Deep molecular response is a critical treatment milestone in the current CML landscape\textsuperscript{14}

IRIS: MR4.5 analysis\textsuperscript{13}
Assessment of MR4.5 was an exploratory analysis and was calculated at each time point for the ITT population and by those who could be evaluated.

IMPORTANT SAFETY INFORMATION (cont)
- Motor vehicle accidents involving patients receiving GLEEVEC\textsuperscript{\textregistered} (imatinib mesylate) tablets have been reported. Advise patients that they may experience side effects such as dizziness, blurred vision, or somnolence during treatment with GLEEVEC. Caution is recommended when driving a car or operating machinery.
- A decline in renal function may occur in patients receiving GLEEVEC. Evaluate renal function at baseline and during therapy, with attention to risk factors for renal dysfunction such as preexisting renal impairment, diabetes mellitus, hypertension, and congestive heart failure.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Preventing progression to advanced stages of CML is an important treatment goal according to NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®)⁵

- Patients with CML who progress to AP or BC are at risk for lower survival and have fewer options to regain disease control⁵,⁶
- Disease progression was assessed in all of the pivotal TKI trials, though the measures vary: PFS versus progression to advanced disease stage

**Pivotal Trial** | **Progression Assessment**
--- | ---
IRIS | Progression to AP/BC was the primary end point and assessed throughout follow-up¹
ENSENd | Progression to AP/BC or CML-related death was a key secondary end point and was assessed throughout follow-up²
DASISION | Transformation to AP/BC was an exploratory end point³
BFORE | Transformation to AP/BC was included in the criteria for EFS, which was a key secondary end point⁴

**IRIS: 10-year analysis of progression to AP/BC¹³**

- 38 patients of 553 progressed to AP/BC in 10 years on GLEEVEC® (imatinib mesylate) tablets

**ENSENd: 10-year analysis of progression to AP/BC¹⁷**

- 2 patients of 282 progressed to AP/BC in 6 months vs 12 patients of 283 in 2 years on GLEEVEC

**DASISION: 5-year analysis of transformation to AP/BC¹⁹**

- 8 patients of 259 progressed to AP/BC in 5 years vs 15 patients of 260 in 5 years on GLEEVEC

**BFORE: 2-year analysis of transformation to AP/BC¹⁸**

- 6 patients of 246 transformed to AP/BC in 2 years vs 7 patients of 241 in 2 years on GLEEVEC

**IMPORTANT SAFETY INFORMATION (cont)**

- In Ph+ CML trials,⁸ severe (grades 3/4) lab abnormalities included neutropenia (3.6%-48%), anemia (1%-42%), thrombocytopenia (<1%-33%), and hepatotoxicity (<1%-5%). Severe (grades 3/4) adverse reactions experienced by Ph+ CML patients who received GLEEVEC in clinical studies included hemorrhage (1.8%-19%), fluid retention (eg, pleural effusion, pulmonary edema, and ascites) (2.5%-11%), superficial edema (1.5%-6%), and musculoskeletal pain (2%-9%).⁹ Severe fluid retention appears to be dose related, was more common in the advanced phase studies (where the dosage was 600 mg/day), and is more common in the elderly. In an additional study of patients with Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, severe (grades 3/4) adverse reactions and those with rates greater than 1% were diarrhea (4%), nausea (2%), and rash (2%).

⁹For more detailed study information, please click here for full Prescribing Information.

Numbers indicate the range of percentages in 4 studies among patients with newly diagnosed Ph+ CML, patients in blast crisis, in accelerated phase, and in the chronic phase after failure of interferon-alpha therapy.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Extending survival is an important treatment goal

Overall survival was assessed in all of the pivotal TKI trials. Median overall survival was not yet reached in these trials.

<table>
<thead>
<tr>
<th>Pivotal Trial</th>
<th>Overall Survival Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRIS</td>
<td>Overall survival was a long-term primary end point and was assessed throughout follow-up^{13}</td>
</tr>
<tr>
<td>ENESTnd</td>
<td>Overall survival was a key secondary end point and was assessed throughout follow-up^{20}</td>
</tr>
<tr>
<td>DASISION</td>
<td>Overall survival was a secondary end point^{9}</td>
</tr>
<tr>
<td>BFORE</td>
<td>Overall survival was a key secondary end point^{6}</td>
</tr>
</tbody>
</table>

IRIS: 10-year estimated survival^{13}

**GLEEVEC (imatinib mesylate) tablets**

- 83.3% of 553 (95% CI, 80.1%-86.6%) (A range of 64.4%-84.4% reflects 111 patients with unknown survival status at time of final analysis, assuming either all patients were alive or all patients had died at time of analysis)

**IFN + Cytarabine**

- 78.8% of 553 (95% CI, 75.0%-82.5%)

ENESTnd: 10-year estimated survival^{17}

<table>
<thead>
<tr>
<th>Nilotinib</th>
<th>87.6% of 282 (95% CI, 83.5%-91.7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLEEVEC</td>
<td>88.3% of 283 (95% CI, 84.2%-92.4%)</td>
</tr>
</tbody>
</table>

Overall survival (all deaths) was defined as the time between randomization and death due to any cause at any time during the study, including the follow-up period after treatment discontinuation. Median overall survival was not reached in either arm. At 5 years, the estimated survival rate was 93.7% (95% CI, 90.8%-96.6%) for patients on nilotinib and 91.7% (95% CI, 88.3%-95.0%) for patients on imatinib.^{21}

DASISION: 5-year estimated survival^{15,19}

<table>
<thead>
<tr>
<th>Dasatinib</th>
<th>91% of 259 (95% CI, 86.6%-93.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLEEVEC</td>
<td>90% of 260 (95% CI, 85.2%-92.8%)</td>
</tr>
</tbody>
</table>

BFORE: 2-year estimated survival^{18}

<table>
<thead>
<tr>
<th>Bosutinib</th>
<th>99% of 268 (95% CI NR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLEEVEC</td>
<td>97% of 268 (95% CI NR)</td>
</tr>
</tbody>
</table>

IMPORTANT SAFETY INFORMATION (cont)

- CYP3A4 is the major enzyme responsible for the metabolism of GLEEVEC. Concomitant administration of GLEEVEC and strong CYP3A4 inducers may reduce total exposure of GLEEVEC; consider alternative agents. Concomitant administration of GLEEVEC and strong CYP3A4 inhibitors may result in a significant GLEEVEC exposure increase. Grapefruit juice should be avoided because it may increase plasma concentrations of GLEEVEC. GLEEVEC will also increase plasma concentrations of other CYP3A4 metabolized drugs (eg, triazolo-benzodiazepines, dihydropyridine calcium channel blockers, certain HMG-CoA reductase inhibitors, etc). Use caution when administering GLEEVEC with CYP3A4 and CYP2D6 substrates that have a narrow therapeutic window. Because warfarin is metabolized by CYP2C9 and CYP3A4, use low-molecular weight or standard heparin instead of warfarin.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Overview of frequently reported adverse events in TKI pivotal trials

**IRIS: 10-year safety analysis**

<table>
<thead>
<tr>
<th>Treatment discontinuation due to adverse events</th>
<th>6.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GLEEVEC® (imatinib mesylate) tablets</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Most common adverse reactions (≥10%)**

Fluid retention (superficial edema), nausea, muscle cramps, musculoskeletal pain, diarrhea, rash, fatigue, headache, joint pain, abdominal pain, nasopharyngitis, hemorrhage, myalgia, vomiting, dyspepsia, cough, pharyngolaryngeal pain, upper respiratory tract infection, dizziness, pyrexia, weight increased, insomnia, depression, influenza, bone pain, constipation, sinusitis.

**ENESTnd: 10-year safety analysis**

<table>
<thead>
<tr>
<th>Treatment discontinuation due to adverse events</th>
<th>22.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nilotinib</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Most common adverse reactions (≥10%)**

Nilotinib 300 mg bid: rash, headache, nasopharyngitis, ALT increased, arthralgia, fatigue, back pain, constipation, nausea, pruritus, diarrhea, myalgia, upper respiratory tract infection, cough, myelosuppression (thrombocytopenia, neutropenia, anemia), hyperbilirubinemia, pain in extremity, AST increased, abdominal pain upper, vomiting, abdominal pain, hypertension, hypophosphatemia, pyrexia, influenza, alopecia, asthenia, insomnia, muscle spasms, lipase increased, blood bilirubin increased, dizziness, dyspnea, edema peripheral, dry skin, oropharyngeal pain, hypercholesterolemia, dyspepsia, musculoskeletal pain, hyperglycemia, decreased appetite.

**DASISION: 5-year safety analysis**

<table>
<thead>
<tr>
<th>Treatment discontinuation due to intolerance*</th>
<th>16%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dasatinib</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Most common adverse reactions (≥10%)**

Dasatinib 100 mg qd: fluid retention (pleural effusion, superficial localized edema), diarrhea, musculoskeletal pain, rash, headache, abdominal pain, fatigue, nausea, neutropenia, thrombocytopenia, anemia.

**GLEEVEC: fluid retention (superficial localized edema), diarrhea, musculoskeletal pain, rash, headache, fatigue, nausea, myalgia, arthralgia, vomiting, muscle spasms, neutropenia, thrombocytopenia**

**BFORE: 1-year safety analysis**

<table>
<thead>
<tr>
<th>Treatment discontinuation due to adverse events</th>
<th>12.7%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bosutinib</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Most common adverse reactions (≥10%)**

Bosutinib 400 mg qd: diarrhea, nausea, thrombocytopenia, rash, ALT increased, AST increased, abdominal pain, anemia, headache, fatigue, vomiting, lipase increased, pyrexia, respiratory tract infection, neutropenia, arthralgia, appetite decreased.

**GLEEVEC: diarrhea, nausea, thrombocytopenia, rash, abdominal pain, anemia, headache, fatigue, vomiting, respiratory tract infection, neutropenia, arthralgia**

Safety Overview

As decided by investigator. Intolerance is defined as recurrent grade ≥3 hematologic toxicity or grade ≥2 nonhematologic toxicity requiring discontinuation despite dose reduction.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
Overview of CV events observed in TKI pivotal trials

The definitions and reporting of CV events differed in the pivotal TKI trials, as is reflected in the observed rates of adverse events. The time points of the follow-up analysis also vary, based on individual study protocol and timing.

IRIS: 10-year analysis of serious cardiac adverse events

Definitions per study publication:
Serious cardiovascular disorders included: myocardial infarction; angina pectoris; coronary artery disease; acute myocardial infarction; unstable angina; arteriosclerosis; coronary artery; ischemic cardiomyopathy; atrial fibrillation; cardiac arrest; congestive cardiac failure; arrhythmia; left ventricular dysfunction; cardiac failure; bradycardia; pericardial effusion; cardiac-respiratory arrest; venous fibrillation; ventricular tachycardia; sick sinus syndrome; supraventricular tachycardia; tachycardia of junction; ventricular extra systoles; nodal arrhythmia; cardiomyopathy; cardiac tamponade; aortic valve stenosis; cardiovascular disorder; palpitations; pericarditis

ENESTnd: 10-year analysis of cardiovascular disease

Definitions per study publication:
Cardiovascular diseases include: angina pectoris; coronary artery disease; myocardial infarction; coronary artery occlusion; acute myocardial infarction; angina unstable; coronary artery stenosis; blood creatine phosphokinase MB increased; Troponin T increased; troponin increased; troponin I increased; transient ischemic attack; subdural hemorrhage; subdural hematoma; paralysis; cerebrovascular disorder; baxial artery stenosis; amnousis fugax; monoparesis; hemiparesis; cerebral ischemia; cerebral infarction; carotid artery stenosis; aphasis; ischemic stroke; cerebral hemorrhage; cerebrovascular accident; peripheral arterial occlusive disease; peripheral artery stenosis; intermittent claudication; peripheral ischemia; arterial occlusive disease

DASISION: 5-year analysis of any-cause arterial ischemic events

Definitions per study publication:
Arterial ischemic events: myocardial infarction; angina pectoris; coronary artery disease; acute coronary syndrome; transient ischemic attack; peripheral arterial disease

BFORE: 1-year analysis of any vascular events

Definitions per study publication:
Vascular events: coronary artery disorders; angina pectoris; coronary artery disease; myocardial ischemia; coronary artery occlusion; acute coronary syndrome; central nervous system hemorrhages; cerebrovascular accidents; central nervous system vascular disorders NEC; transient cerebrovascular events; vascular imaging procedures NEC, vascular therapeutic procedures NEC, arteriosclerosis; stenosis; vascular insufficiency; necrosis; embolism; thrombosis; arterial therapeutic procedures (excluding aortic); non-site specific vascular disorders NEC; peripheral vascular disorders NEC (excluding flushing and hot flush)

IMPORTANT SAFETY INFORMATION (cont)
- Patients with moderate renal impairment (CrCl=20-39 mL/min) should receive a 50% decrease in the recommended starting dose; future doses can be increased as tolerated. Doses greater than 600 mg are not recommended in patients with mild renal impairment (CrCl=40-59 mL/min). For patients with moderate renal impairment, doses greater than 400 mg are not recommended. GLEEVEC should be used with caution in patients with severe renal impairment.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.
IMPORTANT SAFETY INFORMATION

• GLEEVEC is often associated with edema and, occasionally, serious fluid retention. Severe fluid retention was reported in 9% to 13.1% and 2.5% to 11% of patients taking GLEEVEC for GIST and CML, respectively. Patients should be weighed and monitored regularly for signs and symptoms of fluid retention, which can be serious or life threatening, and be advised to report any rapid, unexpected weight gain. The probability of edema tended to be increased among older patients (>65 years) or those taking higher doses of GLEEVEC. Severe edema and superficial edema were observed in 182 (11.1%) GIST patients and 1.5% to 6% in CML patients, respectively. If severe fluid retention occurs, manage with diuretic therapy and withhold GLEEVEC until the event has resolved, and then resume, depending on the initial severity of the event. In a study of patients with newly diagnosed Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, severe (grade 3 or 4) fluid retention occurred in 2.5% of patients receiving GLEEVEC and in 3.9% of patients receiving nilotinib. Edemases of pulmonary edema were observed in 2.1% (none were grade 3 or 4) of patients in the GLEEVEC arm and 2.2% (0.7%, grade 3 or 4) of patients in the nilotinib arm.

• Cytophenias have been reported. Complete blood counts should be performed weekly for the first month, biweekly for the second month, and periodically thereafter as clinically indicated (eg, every 2-3 months). Dose reduction, treatment interruption, or in rare cases discontinuation of treatment may be required for severe neutropenia or thrombocytopenia (see full Prescribing Information for dose adjustment recommendations).

• Congestive heart failure and left ventricular dysfunction (LVD) have been reported. Most patients with reported cardiac events have had other comorbidities and risk factors, including advanced age and previous medical history of cardiac disease. In a phase 3 study of patients with newly diagnosed Ph+ CML in chronic phase, severe cardiac failure and LVD occurred in 0.7% of GLEEVEC patients vs 0.9% of IFN+Ara-C patients. In a study of newly diagnosed Ph+ CML patients in chronic phase comparing GLEEVEC and nilotinib, cardiac failure was observed in 1.1% and 2.2% of patients, respectively. Severe (grade 3 or 4) cardiac failure occurred in 0.7% of patients in each group. Patients with cardiac disease, risk factors for cardiac disease, or history of renal failure should be monitored carefully, and any patient with signs or symptoms consistent with cardiac or renal failure should be evaluated and treated.

• Hepatotoxicity, occasionally severe, may occur. Cases of fatal liver failure and severe liver injury requiring liver transplants have been reported with both short-term and long-term use of GLEEVEC. Monitor of hepatic function is recommended. A 25% decrease in the recommended dose should be used for patients with severe hepatic impairment. If severe hepatotoxicity occurs, GLEEVEC should be withheld until the event has resolved and then resumed, depending on the initial severity of the event.

• When GLEEVEC is combined with chemotherapy, liver toxicity in the form of transaminase elevation and hyperbilirubinemia has been observed. Additionally, there have been reports of acute liver failure. Monitoring of hepatic function is recommended.

• In the newly diagnosed CML trial of GLEEVEC vs IFN+Ara-C, 1.8% of patients had grade 3/4 hemorrhage. Assess liver function before initiation of treatment and monthly thereafter, or as clinically indicated. GI hemorrhage occurred in 1.4% and 2.9% of patients, respectively. None of these events were grade 3 or 4 in the GLEEVEC arm; 0.7% were grade 3 or 4 in the nilotinib arm.

• GLEEVEC is sometimes associated with GI irritation. There have been rare reports, including fatalities, of GI perforation.

• Bullous dermatologic reactions (eg, erythema multiforme and Stevens-Johnson syndrome) have also been reported. In some cases, the reaction occurred upon rechallenge. Several postmarketing reports describe patients able to tolerate the reintroduction of GLEEVEC at a lower dose, with or without concomitant corticosteroids or antihistamines following resolution or improvement of the bullous reaction.

• Clinical cases of hypothyroidism have been reported in thyroxine replacement during treatment with GLEEVEC. TSH levels should be closely monitored in such patients.

• Fetal harm can occur when administered to a pregnant woman. Test pregnancy status in females of reproductive potential prior to GLEEVEC initiation. Advise sexually active females of reproductive potential to avoid pregnancy and use effective contraception (methods that result in <1% pregnancy rates) when taking GLEEVEC and for 14 days after stopping GLEEVEC. Advise women to avoid breast-feeding, and have withdrawal of breast-feeding after the last dose because of the potential for serious adverse reactions in breastfed infants. If pregnancy occurs while taking GLEEVEC, apprise the patient of the potential hazard to the fetus.

• Growth retardation has been reported in children and preadolescents receiving GLEEVEC. The long-term effects of prolonged treatment with GLEEVEC on growth in children are unknown; therefore, monitoring of growth in children taking GLEEVEC is recommended.

• Cases of tumor lysis syndrome (TLS), including fatal cases, have been reported. The patients at risk for TLS are those with tumors having a high proliferative rate or high tumor burden prior to treatment. Therefore, patients should be monitored closely and appropriate precautions taken. Correction of clinically significant dehydration and treatment of high uric acid levels are recommended prior to initiation of GLEEVEC.

• Motor vehicle accidents involving patients receiving GLEEVEC have been reported. Advise patients that they may experience side effects such as dizziness, blurred vision, or somnolence during treatment with GLEEVEC. Caution is recommended when driving a car or operating machinery.

• A decline in renal function may occur in patients receiving GLEEVEC. Evaluate renal function at baseline and during therapy with attention to risk factors for renal dysfunction such as preexisting renal impairment, diabetes mellitus, hypertension, and congestive heart failure.

• In Ph+ CML trials, severe (grades 3/4) lab abnormalities included neutropenia (3.6%-48%), anemia (1%-42%), thrombocytopenia (<1%-33%), and hepatotoxicity (~5%). Severe (grades 3/4) adverse reactions experienced by Ph+ CML patients who received GLEEVEC in clinical studies included hemorrhage (1.8%-19%), fluid retention (eg, pleural effusion, pulmonary edema, and ascites) (2.5%-11%), superficial edema (1.5%-6%), and musculoskeletal pain (2%-9%). Severe fluid retention appears to be dose related, was more common in the advanced phase studies (where the dosage was 600 mg/day), and is more common in the elderly. In an additional study of patients with Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, severe (grades 3/4) adverse reactions and those with rates greater than 1% were diarrhea (4%), nausea (2%), and rash (2%).

• CYP3A4 is the major enzyme responsible for the metabolism of GLEEVEC. Concomitant administration of GLEEVEC and strong CYP3A4 inducers may reduce total exposure of GLEEVEC; consider alternative agents. Concomitant administration of GLEEVEC and strong CYP3A4 inhibitors may result in a significant GLEEVEC exposure increase. Grapefruit juice should be avoided because it may increase plasma concentrations of GLEEVEC. GLEEVEC will also increase plasma concentrations of other CYP3A4 metabolized drugs (eg, triazolo-benzodiazepines, dihydropyridine calcium channel blockers, certain HMG-CoA reductase inhibitors, etc). Use caution when administering GLEEVEC with CYP3A4 and CYP2D6 substrates that have a narrow therapeutic window. Because warfarin is metabolized by CYP2C9 and CYP3A4, use low-molecular weight or standard hepinoxin instead of warfarin.

*For more detailed study information, please click here for full Prescribing Information.

1Numbers indicate the range of percentages in 4 studies among patients with newly diagnosed Ph+ CML patients in blast crisis, in accelerated phase, and in the chronic phase after failure of interferon-alpha therapy.
• Patients with moderate renal impairment (CrCl=20-39 mL/min) should receive a 50% decrease in the recommended starting dose; future doses can be increased as tolerated. Doses greater than 600 mg are not recommended in patients with mild renal impairment (CrCl=40-59 mL/min). For patients with severe renal impairment, doses greater than 400 mg are not recommended. GLEEVEC should be used with caution in patients with severe renal impairment

Common Side Effects of GLEEVEC Tablets

• Almost all adult Ph+ CML patients who received GLEEVEC in clinical studies experienced adverse reactions at some time. In 4 Ph+ CML studies, the most frequently reported adverse reactions (all grades) and those with rates greater than 45% were: superficial edema (60%-74%), nausea (50%-73%), diarrhea (43%-57%), hemorrhage (29%-57%), musculoskeletal pain (38%-49%), fatigue (39%-48%), rash and related terms (36%-47%), muscle cramps (28%-62%), and vomiting (23%-58%). In an additional study of patients with newly diagnosed Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, the most frequently reported adverse reactions (all grades) and those with rates greater than 15% were: diarrhea (46%), nausea (41%), muscle spasm (34%), vomiting (27%), headache (23%), nasopharyngitis (21%), fatigue (20%), peripheral edema (20%), rash (19%), myalgia (19%), eyelid edema (19%), arthralgia (17%), back pain (17%), and pain in extremity (16%)

• Supportive care may help reduce the severity of some mild to moderate adverse reactions. However, in some cases, either a dose reduction or interruption of treatment may be necessary.

• Doses of 400 mg or 600 mg should be administered once daily, whereas a dose of 800 mg may be administered at 400 mg twice a day. For daily dosing of 800 mg and above, dosing should be accompanied using the 400-mg tablet to reduce exposure to iron

• GLEEVEC tablets should be taken with food and a large glass of water to minimize GI irritation

• Patients should be instructed to take GLEEVEC exactly as prescribed and not to change their dose or stop taking GLEEVEC unless they are told to do so by their doctor. If patients miss a dose, they should be advised to take their dose as soon as possible unless it is almost time for their next dose. In which case the missed dose should not be taken. A double dose should not be taken to make up for any missed dose

*Numbers indicate the range of percentages in 4 studies among patients with newly diagnosed Ph+ CML, patients in blast crisis, in accelerated phase, and in the chronic phase after failure of interferon-alpha therapy.

References:
GLEEVEC® (imatinib mesylate) tablets are indicated for:

- Newly diagnosed adult and pediatric patients with Philadelphia chromosome–positive chronic myeloid leukemia (Ph+ CML) in the chronic phase
- Patients with Ph+ CML in blast crisis (BC), accelerated phase (AP), or in the chronic phase (CP) after failure of interferon-alpha therapy

IMPORTANT SAFETY INFORMATION

- GLEEVEC is often associated with edema and, occasionally, serious fluid retention. Severe fluid retention was reported in 9% to 13.1% and 2.5% to 11% of patients taking GLEEVEC for GIST and CML, respectively. Patients should be weighed and monitored regularly for signs and symptoms of fluid retention, which can be serious or life threatening, and be advised to report any rapid, unexpected weight gain. The probability of edema tended to be increased among older patients (>65 years) or those taking higher doses of GLEEVEC. Severe edema and superficial edema were observed in 182 (11.1%) GIST patients and 1.5% to 6% in CML patients, respectively. If severe fluid retention occurs, manage with diuretic therapy and withhold GLEEVEC until the event has resolved, and then resume, depending on the initial severity of the event. In a study of patients with newly diagnosed Ph+ CML in chronic phase comparing GLEEVEC and nilotinib, severe (grade 3 or 4) fluid retention occurred in 2.5% of patients receiving GLEEVEC and in 3.9% of patients receiving nilotinib. Effusions or pulmonary edema were observed in 2.1% (none were grade 3 or 4) of patients in the GLEEVEC arm and 2.2% (0.7% grade 3 or 4) of patients in the nilotinib arm.

Please see additional GLEEVEC Important Safety Information on pages 24-26, and click here for full Prescribing Information.