Forward-looking statements

This presentation contains forward-looking statements as defined in the Private Securities Litigation Reform Act of 1995, as amended. The words "aim," "may," "will," "could," "would," "should," "expect," "plan," "anticipate," "intend," "believe," "estimate," "predict," "project," "potential," "continue," "target" and similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words. In this presentation, forward-looking statements include, without limitation, statements regarding the plans, strategies, timelines and expectations of Blueprint Medicines Corporation (the "Company") for the preclinical and clinical development and commercialization of AYVAKIT™ (avapritinib), pralsetinib and other current or future drug candidates; the plans, timing, design, initiation, enrollment, expectations and announcement of results for the Company's ongoing and planned clinical trials; plans and timelines for submitting marketing applications for avapritinib and pralsetinib and, if approved, commercializing avapritinib in additional geographies or for additional indications or pralsetinib; the potential benefits of any of the Company's current or future approved drugs or drug candidates in treating patients; expectations regarding the Company's existing, cash, cash equivalents and investments; and the Company's strategy, goals and anticipated milestones, business plans and focus.

The Company has based these forward-looking statements on management's current expectations, assumptions, estimates and projections. While the Company believes these expectations, assumptions, estimates and projections are reasonable, such forward-looking statements are only predictions and involve known and unknown risks, uncertainties and other important factors, many of which are beyond the Company's control and may cause actual results, performance or achievements to differ materially from those expressed or implied by any forward-looking statements. These risks and uncertainties include, without limitation, risks and uncertainties related to the impact of the COVID-19 pandemic to the Company's business, operations, strategy, goals and anticipated milestones, including the Company's ongoing and planned research and discovery activities, ability to conduct ongoing and planned clinical trials, clinical supply of current or future drug candidates, commercial supply of current or future approved drugs, and launching, marketing and selling current or future approved drugs; the delay of any current or planned clinical trials or the development of the Company's drug candidates or the licensed drug candidate; the Company's advancement of multiple early-stage efforts; the Company's ability to successfully demonstrate the efficacy and safety of its drug candidates and gain approval of its drug candidates on a timely basis, if at all; the preclinical and clinical results for the Company's drug candidates, which may not support further development of such drug candidates; actions or decisions of regulatory agencies or authorities, which may affect the initiation, timing and progress of clinical trials or marketing applications; the Company's ability to obtain, maintain and enforce patent and other intellectual property protection for any drug candidates it is developing or AYVAKIT; the Company's ability and plans for maintaining a commercial infrastructure, and successfully launching, marketing and selling its current or future approved drugs; the Company's ability to develop and commercialize companion diagnostic tests for any of the Company's current or future approved drugs or drug candidates; and the success of the Company's current and future collaborations, partnerships and licenses.

These and other risks and uncertainties are described in greater detail under "Risk Factors" in the Company's filings with the Securities and Exchange Commission ("SEC"), including its most recent Annual Report on Form 10-K, as supplemented by its most recent Quarterly Report on Form 10-Q, and any other filings it has made or may make with the SEC in the future. The Company cannot guarantee future results, outcomes, levels of activity, performance, developments, or achievements, and there can be no assurance that its expectations, intentions, anticipations, beliefs, or projections will result or be achieved or accomplished. The forward-looking statements in this presentation are made only as of the date hereof, and except as required by law, the Company undertakes no obligation to update any forward-looking statements contained in this presentation as a result of new information, future events or otherwise.

This presentation also contains estimates, projections and other statistical data made by independent parties and by the Company relating to market size and growth and other data about the Company's industry. These data involve a number of assumptions and limitations, and you are cautioned not to give undue weight to such estimates. In addition, projections, assumptions and estimates of the Company's future performance and the future performance of the markets in which the Company operates are necessarily subject to a high degree of uncertainty and risk.
The rapid evolution of Blueprint Medicines

<table>
<thead>
<tr>
<th>IMAGINING A NEW PLATFORM</th>
<th>BUILDING THE PIPELINE</th>
<th>REALIZING THE VISION</th>
</tr>
</thead>
</table>

**HIGHLY SELECTIVE KINASE MEDICINE DISCOVERY PLATFORM**

**RAPID CLINICAL PROOF-OF-CONCEPT ACROSS MULTIPLE PROGRAMS**

Avapritinib in advanced systemic mastocytosis: change in serum tryptase

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Not for promotional use.
1. Unresectable or metastatic disease. 2. CStone Pharmaceuticals has exclusive rights to develop and commercialize avapritinib, pralsetinib and fisogatinib in Mainland China, Hong Kong, Macau and Taiwan. Blueprint Medicines retains all rights in the rest of the world. 3. Approved in the U.S. for the treatment of adults with unresectable or metastatic GIST harboring a PDGFRA exon 18 mutation, including PDGFRA D842V mutations. The proposed MAA indication is unresectable or metastatic GIST harboring a PDGFRA D842V mutation. 4. In collaboration with Roche. Blueprint Medicines has U.S. commercial rights for up to two programs and ex-U.S. commercialization rights for up to two programs. 1L, first-line; 2L, second-line; GIST, gastrointestinal stromal tumors; HCC, hepatocellular carcinoma; MAA, marketing authorization application; MTC, medullary thyroid cancer; NDA, new drug application; NSCLC, non-small cell lung cancer; SM, systemic mastocytosis.

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**Avapritinib (KIT & PDGFRA)**

- **PDGFRA GIST**
  - 1,2,3
- **Advanced SM**
  - 2
- **Indolent SM**
  - 2

**Pralsetinib (RET)**

- **2L RET+ NSCLC**
  - 1,2
- **1L RET+ NSCLC**
  - 1,2
- **EGFR+ NSCLC (+osimertinib)**
  - 1,2
- **2L MTC**
  - 1,2
- **1L MTC**
  - 1,2
- **Other RET-altered solid tumors**
  - 1,2

**Fisogatinib (FGFR4)**

- **Advanced HCC**
  - 2
- **Advanced HCC (+CS1001)**
  - 2

**BLU-263 (KIT)**

- **Indolent SM**

**BLU-945 (EGFR+ triple mutant)**

- **EGFR+ NSCLC**
  - 1

(EGFR+ double mutant)

- **EGFR+ NSCLC**
  - 1

(2 undisclosed targets)

- **EGFR+ NSCLC**
  - 1

(MAP4K1)

- **EGFR+ NSCLC**
  - 1

(3 undisclosed immunokinase targets)

- **EGFR+ NSCLC**
  - 1

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Pralsetinib: an investigational precision therapy for RET-altered cancers

LATE CLINICAL DEVELOPMENT

U.S. REGULATORY SUBMISSION STATUS

RET+ NSCLC
Submitted

RET+ thyroid cancer
June 2020*

Other RET+ solid tumors

PRALSETINIB
POTENT AND HIGHLY SELECTIVE RET INHIBITOR

NDA for RET+ NSCLC granted priority review with November 23, 2020 PDUFA action date

* Planned NDA submission. Kinome illustration reproduced courtesy of Cell Signaling Technology, Inc. (www.cellsignal.com) (CSTI). The foregoing website is maintained by CSTI, and Blueprint Medicines is not responsible for its content.

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RET alterations: oncogenic drivers lacking a targeted therapeutic approach

Non-small cell lung cancer: 
~1-2% RET fusions

Advanced medullary thyroid cancer: 
~90% RET mutations

Papillary thyroid cancer: 
~20% RET fusions

Multiple other tumor types <1% RET-altered, including:
- esophageal
- pancreatic
- breast
- melanoma
- colorectal
- leukemia

Robust clinical activity in NSCLC patients regardless of prior therapy

Data presented at ASCO 2020 virtual annual meeting. Data cut off: November 18, 2019. 1. Two responses pending confirmation at the time of data cut off were subsequently confirmed. CI, confidence interval.

TUMOR SHRINKAGE PER CENTRAL RADIOLOGY

OVERALL RESPONSE RATE

Prior platinum chemo (n=80)¹
- 61% (95% CI: 50-72%)

No prior systemic therapy (n=26)
- 73% (95% CI: 52-88%)

12% complete response rate in patients with no prior systemic therapy

Data presented at ASCO 2020 virtual annual meeting. Data cut off: November 18, 2019. 1. Two responses pending confirmation at the time of data cut off were subsequently confirmed. CI, confidence interval.

Not for promotional use.
Prolonged duration of response in NSCLC patients regardless of prior therapy

Data presented at ASCO 2020 virtual annual meeting. Data cut off: November 18, 2019. CR, complete response; PR, partial response. NR, not reached.

Median DOR

(95% CI: 11.3 m - NR)

86%

6-month DOR

74%

Responders on treatment

Not for promotional use.
Robust clinical activity in MTC patients regardless of prior therapy


TUMOR SHRINKAGE PER CENTRAL RADIOLOGY

OVERALL RESPONSE RATE

Prior MKI treatment (n=53)
60% (95% CI: 46-74%)

No prior systemic therapy (n=19)
74% (95% CI: 49-91%)

Tumor shrinkage in 99% of patients regardless of prior therapy


Not for promotional use.
Prolonged duration of response in patients with previously treated MTC


Median DOR: 96% (95% CI: NE-NE)
6-month DOR: NR

Not for promotional use.
Deep and durable responses in patients with RET fusion+ thyroid cancer


**TUMOR SHRINKAGE PER CENTRAL RADIOLOGY**

**RET FUSION+ THYROID CANCER**
**ALL DOSES (N=11)**

- **ORR**: 91% (95% CI: 59-100%)
- **6-month DOR**: 100%

10/11 patients previously treated with systemic therapy.


Not for promotional use.
Pralsetinib is well-tolerated in patients with advanced cancer

- Only 4% discontinued due to treatment-related AEs
- Low ≥Grade 3 hypertension
- Low ≥Grade 3 AST/ALT elevations
- No clinically or statistically significant QT prolongation observed in QT sub-study
- No treatment-related hypersensitivity

### Treatment-related adverse events in ≥15% of patients

<table>
<thead>
<tr>
<th>AE preferred term</th>
<th>Any grade (%)</th>
<th>Grade ≥3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST increased</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Anemia</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>ALT increased</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Constipation</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Neutropenia</td>
<td>19</td>
<td>10</td>
</tr>
</tbody>
</table>


Natural history data highlight importance of drug safety profile in advanced cancer patients:
67% of NSCLC patients have ≥1 CV comorbidity, with ~10% experiencing a CV event.

Not for promotional use.
Our plan to deliver a best-in-class selective RET inhibitor to patients

**DIFFERENTIATED CLINICAL PROFILE**

Data showing deep responses, long-lasting benefit, tolerability and convenience

**PATIENT- AND HEALTHCARE PROVIDER-CENTERED APPROACH**

Tailored support enabling patient identification, ease of prescribing and ongoing patient management

**HIGHLY EXPERIENCED, NIMBLE TEAM**

Fully-integrated launch-ready team in place, 2/3 with prior lung cancer experience
Avapritinib: a precision therapy with broad potential

**AVAPRITINIB**
POTENT AND HIGHLY SELECTIVE KIT AND PDGFRA INHIBITOR

**PDGFRA exon 18 mutant GIST**
- APPROVED

**Advanced SM**
- 2H 2020*

**Indolent and smoldering SM**

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1. Approved in the U.S. for the treatment of adults with unresectable or metastatic GIST harboring a PDGFRA exon 18 mutation, including PDGFRA D842V mutations.
2. Planned NDA submission. Kinome illustration reproduced courtesy of Cell Signaling Technology, Inc. (www.cellsignal.com) (CSTI). The foregoing website is maintained by CSTI, and Blueprint Medicines is not responsible for its content. CHMP; EMA Committee for Medicinal Products for Human Use; EMA, European Medicines Agency.
3. Not for promotional use.

Anticipate EMA CHMP opinion on avapritinib MAA for PDGFRA D842V GIST in Q3 2020

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*Not for promotional use.*
Strong early AYVAKIT execution establishes a foundation for anticipated launches in RET-altered cancers and systemic mastocytosis

![AYVAKIT](image)

With transformative therapies and superior service, we aim to be recognized as the leader in precision medicine by hematology/oncology centers of excellence.

<table>
<thead>
<tr>
<th>STRATEGIC IMPERATIVES</th>
<th>ACHIEVEMENTS THROUGH Q1 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive positive first experiences with AYVAKIT</td>
<td>&gt;100 unique prescribers, with ~40% in community setting</td>
</tr>
<tr>
<td>Deliver best-in-class patient support</td>
<td>~80% of prescriptions processed through YourBlueprint™</td>
</tr>
<tr>
<td></td>
<td>&gt;90% of commercial and Medicare lives covered at or better than label</td>
</tr>
<tr>
<td>Catalyze patient identification</td>
<td>Precision medicine team actively engaged at national and regional levels to drive patient identification across portfolio</td>
</tr>
</tbody>
</table>

$3.5M in net sales achieved in first partial quarter of launch

Full prescribing information is available at [www.AYVAKIT.com](http://www.AYVAKIT.com).

Not for promotional use.
Systemic mastocytosis is one disease driven by KIT D816V

**Advanced SM**

- Debilitating symptoms
- Significant organ involvement
- Requirement of high intensity treatment

**Non-advanced SM**

(Indolent and smoldering)

- Requirement for life-long chronic treatment

~75,000 patients in major markets

Patient numbers in major markets based on estimated prevalence for advanced, indolent and smoldering systemic mastocytosis in the US, EU5 and Japan.
Avapritinib is the only highly potent inhibitor of KIT D816V, the common disease driver across systemic mastocytosis


≥25% reduction in KIT D816V MAF is correlated with improved overall survival in advanced SM

EXPLORER trial results: Remarkable response rate and prolonged duration of response in patients with advanced SM

- FDA breakthrough therapy designation
- Robust activity across all disease subtypes
- Median follow up of 21 months with ongoing treatment up to ~3.5 years

EXPLORER trial data reported on December 8, 2019. Data cutoff: August 30, 2019. 2. ORR defined as complete remission with full or partial recovery of peripheral blood counts, partial remission or clinical improvement. 3. Avapritinib granted Breakthrough Therapy Designation for the treatment of advanced SM, including the subtypes of aggressive SM, SM with an associated hematologic neoplasm and mast cell leukemia. 4. After the data cutoff date, one patient with SM and an associated hematologic neoplasm (SM-AHN) of myelodysplastic syndrome had a Grade 5 intracranial bleed. At the time of the bleeding event, the patient had severe thrombocytopenia and experienced a serious injury involving head trauma. DOR, duration of response; OS, overall survival.

Avapritinib was generally well-tolerated, and most AEs were grade 1 or 2
- Most common treatment-emergent AEs were periorbital edema, anemia, diarrhea, fatigue, peripheral edema, nausea, thrombocytopenia, vomiting and cognitive effects
- Across all doses, 6 patients discontinued treatment due to treatment-related AEs

SAFETY
ALL DOSES (N=80)

BEST RESPONSE PER IWG-MRT-ECNM CRITERIA
ALL DOSES (N=48)

77% Confirmed ORR
Median DOR and OS not reached

Not for promotional use.
PIONEER trial results: unparalleled clinical profile in patients with indolent SM

**Improves disease symptoms**

ISM-SAF total symptom score

**Improves quality of life**

MC-QoL total score

**Reduces mast cell burden**

KIT D816V mutant allele fraction

Favorable safety profile supports the selection of avapritinib 25 mg QD as recommended Part 2 dose


Not for promotional use.
Avapritinib 25 mg QD reduces symptoms and mast cell burden in indolent SM

Presented at EAACI Virtual 2020 Congress. Data cut-off: March 31, 2020. *24 weeks or last assessment before, if 24 weeks not available. EAACI, European Academy of Allergy and Clinical Immunology.

Part 2 primary endpoint
≥30% reduction in ISM-SAF Total Symptom Score at 24 weeks

Part 2 first key secondary endpoint
≥50% tryptase reduction at 24 weeks*

Response rate: 0% 60% 0% 70%
Safety results for avapritinib 25mg QD are similar to placebo at 16 weeks\(^1\)

### AE in >15% of placebo or avapritinib arms

<table>
<thead>
<tr>
<th>Preferred term</th>
<th>Placebo n=9</th>
<th>Avapritinib 25 mg n=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of subjects with ≥1 AE</td>
<td>any grade</td>
<td>grade 3</td>
</tr>
<tr>
<td>89</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>Nausea</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Dizziness</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Headache</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Fatigue</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Face edema</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peripheral edema</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Periorbital edema</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bone Pain</td>
<td>22</td>
<td>0</td>
</tr>
</tbody>
</table>

**AVAPRITINIB 25 MG QD**

- No patients had serious AEs
  - 2 patients treated with placebo had serious AEs, 1 with psychogenic seizure and 1 with diffuse cutaneous mastocytosis
- No patients had dose modifications
- No patients discontinued due to AEs

Follow up at 24 weeks showed no ≥grade 3 AEs or discontinuations due to AEs for avapritinib 25 mg QD\(^2\)

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Next steps for PIONEER trial of avapritinib in indolent SM

PIONEER REGISTRATION-ENABLING PART 2

**Design:** Randomized, double-blind, placebo-controlled treatment period, followed by open-label expansion

**Key endpoints:** Response rate defined as ≥30% reduction in ISM-SAF total symptom score (primary), measures of mast cell burden, quality of life, concomitant medications

**Sample size:** ~200 patients

**Duration:** 24 weeks

**Timeline:** Plan to initiate patient screening in June 2020
Based on current operating plans, expect existing cash balance will fund operations into 2H of 2022*

Q1 2020 FINANCIAL RESULTS

<table>
<thead>
<tr>
<th>Statement of Operations (unaudited)</th>
<th>Three Months Ended 3/31/2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue</td>
<td>$6.2M</td>
</tr>
<tr>
<td>Collaboration revenue</td>
<td></td>
</tr>
<tr>
<td>AYVAKIT net sales</td>
<td>$2.7M</td>
</tr>
<tr>
<td></td>
<td>$3.5M</td>
</tr>
<tr>
<td>Cost of sales</td>
<td>&lt; $0.1M</td>
</tr>
<tr>
<td>Research &amp; development expense</td>
<td>$84.1M</td>
</tr>
<tr>
<td>Selling, general &amp; administrative expense</td>
<td>$35.7M</td>
</tr>
<tr>
<td>Net loss</td>
<td>$(111.0)M</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Balance Sheet (unaudited)</th>
<th>3/31/2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash, cash equivalents and investments</td>
<td>$750.4M</td>
</tr>
</tbody>
</table>

* Includes anticipated product revenue and excludes any potential option fees, milestone payments or other payments under collaboration or license agreements.
Key anticipated corporate milestones through 2H 2020

JUNE 2020
- Submit pralsetinib NDA to FDA for RET+ thyroid cancer
- Present updated data from EXPLORER for avapritinib in advanced SM

Q3 2020
- Obtain CHMP opinion from EMA for avapritinib in PDGFRA GIST
- Report top-line EXPLORER and PATHFINDER data for avapritinib in advanced SM

Q4 2020
- Pralsetinib PDUFA action date for RET+ NSCLC NDA
- Submit avapritinib NDA to FDA for advanced SM
- Present BLU-945 preclinical data in resistant EGFR+ NSCLC