Recoding in Action

June 2020

LET'S RECODE THE STORY
forward-looking statements

These slides and the accompanying oral presentation contain forward-looking statements and information. The use of words such as “may,” “might,” “will,” “should,” “expect,” “plan,” “anticipate,” “believe,” “estimate,” “project,” “intend,” “future,” “potential,” or “continue,” and other similar expressions are intended to identify forward-looking statements. For example, all statements we make regarding the initiation, timing, progress and results of our preclinical and clinical studies and our research and development programs, our ability to advance product candidates into, and successfully complete, clinical studies, the timing or likelihood of regulatory filings and approvals, and the timing and likelihood of entering into contracts with payors for value-based payments over time or reimbursement approvals, and our commercialization plans for approved products are forward looking. All forward-looking statements are based on estimates and assumptions by our management that, although we believe to be reasonable, are inherently uncertain. All forward-looking statements are subject to risks and uncertainties that may cause actual results to differ materially from those that we expected. These statements are also subject to a number of material risks and uncertainties that are described in our most recent quarterly report on Form 10-Q, as well as our subsequent filings with the Securities and Exchange Commission. Any forward-looking statement speaks only as of the date on which it was made. We undertake no obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future events or otherwise, except as required by law.
Must Beat the Odds. Period.
Tremendous Progress in Challenging Times

Programs and Pipeline

- ide-cel updated data at ASCO; BLA resubmission targeted for July 2020*
- Clarity on accelerated US regulatory path for SCD (Updated data at EHA)
- Key 2021 milestones tracking: EU TDT ramp, ide-cel launch, US TDT, ALD & SCD filings & pipeline emergence

Operation Plan

- Optimized BMS collaboration & $200M rights monetization
- Revised operating plan by over $500M through mid-2022
- Extended cash runway into 2022

*U.S. BLA to be resubmitted following receipt of RTF disclosed May 13, 2020
Core Four Programs Continue to Progress

- ide-cel
- LentiGlobin SCD
- LentiGlobin TDT
- Lenti-D

- KarMMa Data at ASCO
- BLA Resubmission by July 2020

- Updated Regulatory Path
- Updated Clinical Data and Planned MAA filing in 2020

- HGB-206 Group C Data at EHA
- Ongoing Engagement in EU Phase 3 Data at EHA
Multiple Myeloma - Changing What’s Possible

**Standard of Care***
- ~4 months PFS
- ~30% ORR
- ~3% CR

**ASCO 2020**
- mPFS of 12.1 months at 450x10^6 dose
- CAR+ T cell persistence observed up to 1yr
- KarMMa N=128; CRB-401 N=67

**2020**
- U.S. BLA resubmission targeted by July 2020
- Ongoing studies in 3L, 2L and 1L (Newly Diagnosed)

*Lonial et al, Lancet 2016 (Dara); Siegel et al, Blood 2012 (Kyprolis); Hajek et al, Leukemia 2017 (Kyprolis); Chari et al, NEJM 2019 (Selinexor); Richardson et al, Blood 2014 (PomDex)
Advancing into earlier lines of therapy and continuing to innovate

lines of therapy

- Front line setting phase 1 study open
- 2nd line phase 2 study open
- 2-4 prior lines phase 3 study open
- 4th line+ pivotal study
  - Basis of U.S. BLA Submission
- bb21217 next-gen anti-BCMA CAR T study ongoing

Multiple Myeloma

- KarMMa-4
- KarMMa-2
- KarMMa-3
- KarMMa
- CRB-402

Studies ongoing in partnership with BMS
ide-cel (bb2121) - Positive Pivotal Data at ASCO

- **Heavily pretreated population**
  - Median 6 prior lines of therapy, 94% refractory to anti-CD38, 84% triple refractory
  - All patients were refractory to their last treatment (progression during or within 60 days of last therapy)

- **Deep and durable responses across dose levels**
  - mPFS of >12mo at the 450 x 10^6 dose
  - All patients who had CR or sCR, who were evaluable for minimal residual disease (MRD), were MRD-negative
  - Durability is consistent across doses

- **Safety consistent with the Ph1 data**
  - Gr ≥ 3 CRS and iiNT were reported in <6% of subjects at each target dose
  - CRS and iiNT of any grade occurred in 83.6% and 18% of patients, respectively

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### ORR, n (%)

<table>
<thead>
<tr>
<th>Dose Level</th>
<th>ORR, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SoC</td>
<td>2 (50.0)</td>
</tr>
<tr>
<td>150 x 10^6</td>
<td>48 (68.6)</td>
</tr>
<tr>
<td>300 x 10^6</td>
<td>44 (81.5)</td>
</tr>
<tr>
<td>450 x 10^6</td>
<td>94 (73.4)</td>
</tr>
<tr>
<td>All Doses</td>
<td>44 (81.5)</td>
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</table>

### CR/sCR, n (%)

<table>
<thead>
<tr>
<th>Dose Level</th>
<th>CR/sCR, n (%)</th>
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</thead>
<tbody>
<tr>
<td>SoC</td>
<td>1 (25.0)</td>
</tr>
<tr>
<td>150 x 10^6</td>
<td>20 (28.6)</td>
</tr>
<tr>
<td>300 x 10^6</td>
<td>21 (39)</td>
</tr>
<tr>
<td>450 x 10^6</td>
<td>42 (33)</td>
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<tr>
<td>All Doses</td>
<td>42 (33)</td>
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</table>

### Median DoR, mo

<table>
<thead>
<tr>
<th>Dose Level</th>
<th>Median DoR, mo</th>
</tr>
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<tbody>
<tr>
<td>SoC</td>
<td>...</td>
</tr>
<tr>
<td>150 x 10^6</td>
<td>9.9</td>
</tr>
<tr>
<td>300 x 10^6</td>
<td>11.3</td>
</tr>
<tr>
<td>450 x 10^6</td>
<td>10.7</td>
</tr>
<tr>
<td>All Doses</td>
<td>10.7</td>
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</tbody>
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iiNT: investigator identified neurotoxicity

Ide-cel is being developed in collaboration with Bristol-Myers Squibb
Revised BMS Collaboration: Aligned to Support ide-cel Commercialization

**shared commitment**
- U.S. co-promote/ co-develop intact
- KarMMa development program underway in earlier lines

**monetization**
- bluebird to receive $200m for ex-U.S. milestones and royalties

**manufacturing alignment**
- BMS to manufacture vector ex-U.S. over time
- bluebird to continue U.S. vector manufacturing
Sickle Cell Disease - Daring to Dream

RECODE

- Pre-Tx Transfusions
- More Thorough Conditioning
- Higher Cell Dose
- Higher VCN

EHA 2020

- 99.5% reduction in annualized rate of VOC + ACS*

- Accelerated development underway

*HGB-206 Group C patients with history of VOCs and ACS who had ≥ 6 months of follow-up; data as of March 3, 2020

New England Journal of Medicine 2017
HGB-206 Group C: 99.5% mean reduction of annualized rate of VOCs + ACS post-LentiGlobin treatment

- No ACS or serious VOCs occurred in any Group C patient post-LentiGlobin treatment to date (2.8 – 24.8 months follow-up)
- One previously reported non-serious Grade 2 VOC was observed in 1 patient ~ 3.5 months post-LentiGlobin treatment

Investigator-reported AEs of VOC or ACS are shown; Patients with ≥ 4 VOC/ACS at baseline before IC and with ≥ 6 months of follow-up post-DP infusion are included

ACs, acute chest syndrome; CI, confidence interval; DP, drug product; IC, informed consent; VOC, vaso-occlusive crisis

Data as of 3 March 2020
Updated, accelerated plan based on compelling VOE data

1. **HGB-206 Group C:** Basis of BLA submission in 2H 2021
   - **Primary Endpoint:** Complete resolution of severe VOEs
   - **Key Secondary Endpoint:**
     - HbAT87Q and total Hb
     - ≥ 12 years of age - ≤ 50 years of age
   - Ongoing Phase 1/2, single arm, multi-center, U.S. study
     N=41 (Group C)

2. **Primary endpoint:** VOEs

3. **HGB-210:** Serving as confirmatory study
   - **Phase 3, single arm, multi-center, global study**
   - **Primary Endpoint:** HbAT87Q and Total Hb
   - **Key Secondary Endpoint:**
     - Reduction in severe VOEs
   - Sickle Cell Disease, history of VOEs over 24 months
Transfusion-Dependent β-Thalassemia - Reimagined Future

**RECODE**
Vector Potency & Manufacturing Enhancement

**EHA 2020**
- Northstar-2 (HGB-207): All patients treated, 89% TI
- Northstar-3 (HGB-212): 85% of patients have been off transfusions for > 6 months

**2010**
Nature

- EU Approved 2019
- US rolling BLA initiated 2019

Nature 2010
Completed studies of LentiGlobin for TDT reinforce long term durability of clinical outcomes

**HGB-204 Complete**
- Up to 5 years follow-up with stable HbA^{T87Q} and total Hb
- 8/10 non-β^0/β^0; 3/8 β^0/β^0 remain TI as of data cut-off
- Reduction in liver iron content; cardiac iron remains stable in normal range as of data cut-off

**HGB-205 Complete**
- Stable HbA^{T87Q} and total Hb at up to 5+ years follow-up
- 3/4 non-β^0/β^0 remain TI as of data cut-off
- Substantial improvement in underlying dyserythropoiesis

**HGB-207 non-β^0/β^0 genotypes**
- 21/23 patients treated
- 9/10 patients achieved TI
- Total unsupported Hb is near-normal in most patients as of data cut-off

**HGB-212 β^0/β^0 genotype or IVS-I-110 mutations**
- 13/18 patients treated
- 2/2 patients achieved TI
conditional approval granted in EU for patients with TDT and non-β⁰/β⁰ genotypes

Gene therapy for patients 12 years and older with transfusion-dependent β-thalassemia (TDT) who do not have a β⁰/β⁰ genotype, for whom hematopoietic stem cell (HSC) transplantation is appropriate but a human leukocyte antigen (HLA)-matched related HSC donor is not available
Preparing to serve patients in Europe

Launch expectations:
1. Optimal patient experience through a seamless delivery network
2. Steady country by country launch with progressive build
3. Get the model right for long term success
4. Advance value-based payment over time reimbursement

1 drug product manufacturing
Munich, Germany

Initial launch focus:
- Germany
- Italy
- UK
- France
Establishing Promising Access & Value Foundation

**EU Launch Readiness**
- First ever at-risk value-based agreement signed with multiple Sick Funds in Germany (~50-70% of patients in Germany covered)
- Team in place in Zug, UK, France, Italy, Germany, and Nordic Markets
- Qualified Treatment Centers and manufacturing ready in Germany

**U.S. Launch Readiness**
- Team in place for U.S. commercialization
- Payers (Commercial) - Actively engaging to enable access & value-based payment over time at launch
- Policy (State & Federal) - Focused on enabling value-based payment over time in commercial and for Medicaid markets to drive access
- Distribution - Establishing customized distribution model to serve QTC & payer needs

**Market and Patient Engagement**
- Disease Education and outreach in place
- Patient Advocacy education and initiative support
Cerebral Adrenoleukodystrophy – From Tragedy to Hope

RECODE
Enhanced Construct & Manufacturing

15/17 patients alive and MFD-free at 24 months follow up and continue to be MFD-free with up to 5 years of follow-up

32 total patients treated
Data as of April 25, 2019

2020
• 2H 2020 anticipated MAA submission
• Newborn screening active in 14 US states; several pilot programs in EU
Lenti-D treatment halts CALD disease progression

All patients who were alive and MRD-free at 24 months follow up (15/17; 88%) continue to be MFD-free with up to 5 years of follow-up

- 32 patients have been treated with Lenti-D with a median follow-up time of 21.2 months
- 14 patients are still on study with less than 24 months of follow-up and show no evidence of MFDs
- Three patients did not or will not meet the primary efficacy endpoint; two patients withdrew from the study at investigator discretion, and one experienced rapid disease progression early on-study resulting in MFDs and death.

Safety profile consistent with autologous transplantation

- No GvHD, no graft rejection

Enrollment completed in Starbeam study

Phase 3 ALD-104 study currently enrolling

Data as of April 25, 2019

No GvHD, no graft rejection
### Core Research Principles

<table>
<thead>
<tr>
<th>Programs with the Potential to Transform Patient Lives</th>
<th>Diseases with Definitive Endpoints of Clinical Success</th>
<th>Targets with Human Genetic and/or Functional Validation</th>
<th>Disruptive Solutions to the Problems that Need to be Solved</th>
</tr>
</thead>
<tbody>
<tr>
<td>We tackle diseases with a clear unmet medical need based on the magnitude of impact and not necessarily the number of patients</td>
<td>Clinical success should be objective, measurable, un-incremental, and rapid</td>
<td>Biology may be complex but the role of the target in the disease must be definitive</td>
<td>We don’t do incremental science. We take on the big problems that, if successful, will disrupt our field</td>
</tr>
</tbody>
</table>
Hypothesis: Increasing long-lived, memory-like T cell subsets in the drug product may result in enhanced persistence of functional anti-BCMA CAR T cells *in vivo*
Diffuse Large B-Cell Lymphoma - Triple Threat Approach

<table>
<thead>
<tr>
<th>LAYER</th>
<th>PURPOSE</th>
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<tbody>
<tr>
<td>1</td>
<td>dual-CAR targeting</td>
</tr>
<tr>
<td>2</td>
<td>signal extension</td>
</tr>
<tr>
<td>3</td>
<td>signal amplification</td>
</tr>
</tbody>
</table>

EACH LAYER INFORMS 1: MANY PLATFORM
Path to Patients - Show up bluestyle

Disruptive Science

Disruptive Medicine

Disruptive Commercialization

Not Enough - In the How

At Every Turn, Every Interface

DEEPLY CARE ➔ BE HUMAN
Revised Operating Plan: Committed to Financial and Operational Sustainability

Critical to Plan:

- Core 4: Vision to launch 4 commercial therapies
- Manufacturing: Deep supply chain and established suspension LVV
- Robust Research Engine: Supporting Core 4, expanding Core 4, and promising preclinical programs
- People & Culture: Keeping bluebird BLUE!

Prioritization & Cost Saving:

- Facilities: Taking actions to reduce our facility footprint and fixed cost overhead
- Reduced / Deferred SG&A Build: In line with commercial timing and forecast
- Label-Expanding Studies: HGB-211 indefinitely paused
- Research: Prioritization of preclinical programs

EXTEND CASH RUNWAY INTO 2022
## 2020-2021: BLUE is Prepared and On Track for the Catalysts Ahead

<table>
<thead>
<tr>
<th>2020</th>
<th>2021</th>
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<tbody>
<tr>
<td>✓ LentiGlobin SCD Regulatory Update</td>
<td>• LentiGlobin SCD U.S. BLA submission (2H)</td>
</tr>
<tr>
<td>▪ Lenti-D CALD EU MAA Submissions</td>
<td>• LentiGlobin TDT U.S. BLA submission (Q2/Q3)</td>
</tr>
<tr>
<td>▪ Ide-cel (bb2121) MM U.S. BLA resubmission</td>
<td>• Lenti-D CALD U.S. BLA submission (mid-year)</td>
</tr>
<tr>
<td>✓ Ide-cel (bb2121) KarMMa data at ASCO, CRB-401 by EOY</td>
<td>• Ide-cel KarMMa studies progressing and evolving</td>
</tr>
<tr>
<td>✓ SCD: HGB-206 Data at EHA</td>
<td>• Building and evolving clinical data set on SGD programs</td>
</tr>
<tr>
<td>✓ TDT: HGB-207, HGB-212 Data at EHA</td>
<td></td>
</tr>
<tr>
<td>• Lenti-D ALD-102 data update by EOY</td>
<td></td>
</tr>
<tr>
<td>• ZYNTEGLO Access and Reimbursement established in additional EU countries</td>
<td>• Ide-cel U.S. launch underway</td>
</tr>
<tr>
<td>• ZYNTEGLO first commercial patients treated (2H)</td>
<td>• ZYNTEGLO geographic expansion</td>
</tr>
<tr>
<td>• Ide-cel U.S. launch ready</td>
<td>• LentiGlobin TDT U.S. launch ready and SCD gearing up</td>
</tr>
</tbody>
</table>

### Regulatory
- ✓ LentiGlobin SCD Regulatory Update
- ▪ Lenti-D CALD EU MAA Submissions
- ▪ Ide-cel (bb2121) MM U.S. BLA resubmission

### Clinical Updates
- ✓ Ide-cel (bb2121) KarMMa data at ASCO, CRB-401 by EOY
- ✓ SCD: HGB-206 Data at EHA
- ✓ TDT: HGB-207, HGB-212 Data at EHA
  - • Lenti-D ALD-102 data update by EOY

### Commercial & Foundation Building
- • ZYNTEGLO Access and Reimbursement established in additional EU countries
- • ZYNTEGLO first commercial patients treated (2H)
- • Ide-cel U.S. launch ready