bluebirdbio®

Q2 Earnings Call & Commercial Launch Update

August 8, 2023

NASDAQ: BLUE

forward-looking statements

This presentation contains certain statements that are forward-looking within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, and that involve risks and uncertainties, including without limitations statements regarding the Company's financial condition, results of operations, commercial revenue and key metrics, including the expected number of patient starts, and anticipated reporting and timing thereof; anticipated cash runway, including restricted cash; and anticipated cash burn for 2023 as well as statements regarding the Company's plans and expectations for operations including expected timing relating to its regulatory approvals, plans to expand manufacturing capacity, anticipated growth of its QTC network and timing thereof, plans for future regulatory submissions, the expected timing for the potential PDUFA acceptance and regulatory approval of lovo-cel by FDA, and the timing of commercial launch of lovo-cel, if approved. Statements using words such as "expect", "anticipate", "believe", "may", "will" and similar terms are also forward-looking statements. Such statements are subject to numerous risks and uncertainties, including but not limited to, delays and challenges in our commercialization and manufacturing of our products, including risks associated with demonstrating analytical comparability with respect to our lovo-cel program; we may encounter additional delays in the development of our programs, including the imposition of new clinical holds, that may impact our ability to meet our expected timelines and increase our costs; the internal and external costs required for our ongoing and planned activities, and the resulting impact on expense and use of cash, has been, and may in the future be, higher than expected which has caused us, and may in the future cause us to use cash more quickly than we expect or change or curtail some of our plans or both; substantial doubt exists regarding our ability to continue as a going concern; our expectations as to expenses, cash usage and cash needs may prove not to be correct for other reasons such as changes in plans or actual events being different than our assumptions; the risk that the efficacy and safety results from our prior and ongoing clinical trials will not continue or be seen in additional patients treated with our product candidates; the risk that additional insertional oncogenic or other reportable events associated with lentiviral vector, drug product, or myeloablation will be discovered or reported over time; the risk that any one or more of our products or product candidates, including eli-cel, beti-cel or lovo-cel, will not be successfully developed, approved or commercialized, as applicable, and other risks as may be detailed from time to time in our Annual Reports on Form 10-K and Quarterly Reports on Form 10-Q and other reports we file with the Securities and Exchange Commission. Except as required by law, we undertake no obligations to make any revisions to the forward-looking statements contained in this presentation or to update them to reflect events or circumstances occurring after the date of this presentation, whether as a result of new information, future developments or otherwise.

agenda

Outlook and Q2 2023 key business updates

Andrew Obenshain, chief executive officer

Commercial launch progress

Tom Klima, chief commercial and operating officer

Upcoming milestones

Andrew Obenshain, chief executive officer

Q&A – joined by

Chris Krawtschuk, chief financial officer

Rich Colvin, chief medical officer

bluebirdbio®

pursuing curative gene therapies ...

TO GIVE PATIENTS AND THEIR FAMILIES MORE BLUEBIRD DAYS

bluebird occupies a unique strategic position as a standalone gene therapy company

Clinical & pre-clinical companies

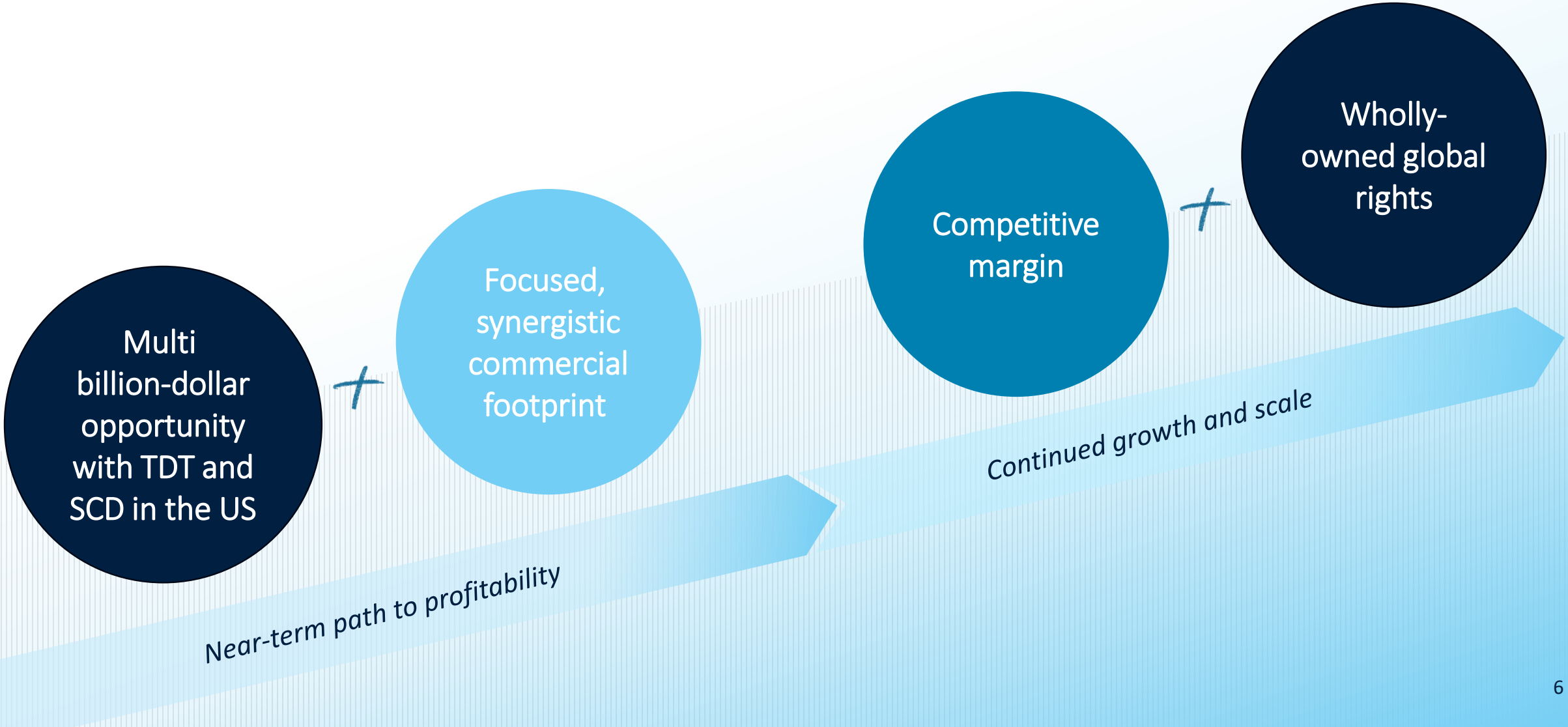
- Established track record for LVV platform
- 2 FDA approvals
- 3rd BLA under priority review

- 10+ years of gene therapy research
  - 180+ patients treated
    - 8 clinical trials

- 2 ongoing US launches
- Transplant and cell therapy infrastructure
- Proven reimbursement

Large cap pharma

bluebird's five-year vision



Second Quarter 2023 Key Business Highlights

Strong launch momentum demonstrating sustainable commercial potential across the platform

ZYNTEGLO

- 11 patient starts to date[1]
- Reimbursement secure with no ultimate denials across government and commercial payers
- 15 QTCs activated; on track for 40-50 QTCs by the end of 2023

SKYSONA

- 5 patient starts to date[1]
- Reimbursement secure with no ultimate denials across government and commercial payers
- 4 QTCs activated

lovo-cel for sickle cell disease granted FDA priority review

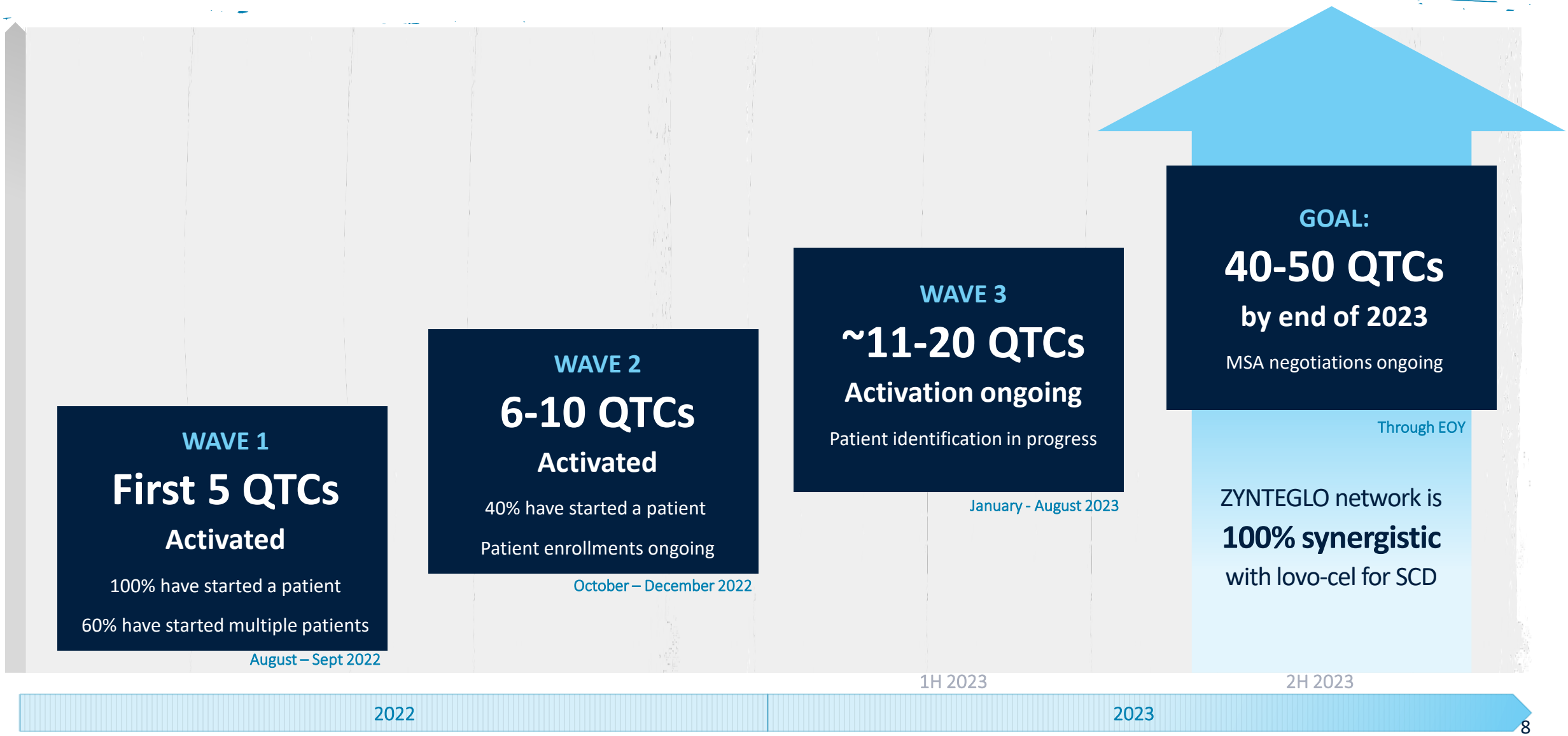
- PDUFA date Dec. 20, 2023; commercial launch expected in early 2024, if approved
- Cost-effective at up to $2.26 million (ICER)
- Positive payer reception to clinical value and outcomes-based approach

Disciplined and effective deployment of capital

- $291 million in cash, cash equivalents, marketable securities and restricted cash as of June 30, 2023[2]
- Reiterating 2023 cash burn guidance of $270 - $300 million
- Cash runway into the fourth quarter of 2024[3]
- $6.8 million in product revenue for the quarter

1. Patient start is defined as cell collection (apheresis); 2. Cash balance contains $45m in restricted cash.; 3. Without the release of our restricted cash, we estimate our cash, cash equivalents and marketable securities as of June 30, 2023 will be sufficient to fund our operations into the second quarter of 2024. Cash Runway is calculated using the cash balance / net burn rate (cash from revenue less cash paid for expenses).

Launch momentum building as on-boarded QTCs gain experience and accelerate patient enrollment



Delivering a consistent manufacturing process is essential for patients, families and providers

ZYNTEGLO® manufacturing process

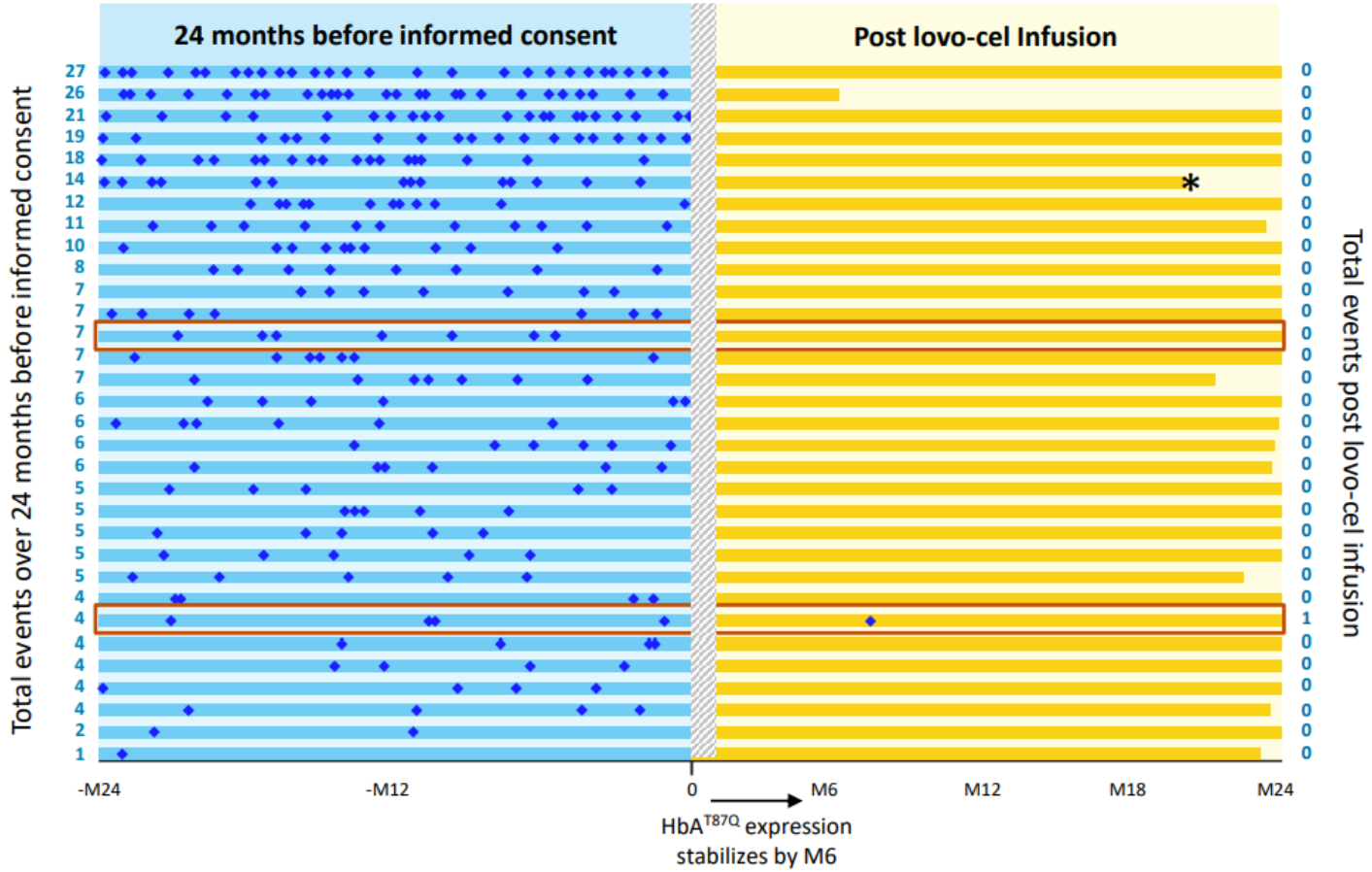
Bulk of time spent on release testing to deliver high quality drug product

Revenue recognized upon infusion

Occurs at QTC Occurs at CMO

ZYNTEGLO is indicated for the treatment of adult and pediatric patients with β-thalassemia who require regular red blood cell (RBC) transfusions.
QTC: Qualified Treatment Center; CMO: Contract Manufacturing Organization

lovo-cel potential approval is based on the most robust and longest follow-up of any gene therapy program for SCD



Data as of Aug 11, 2022

*50 patients treated includes patients from HGB-205, HGB-206 Group A, Group B and Group C and HGB-210

BLA under priority review for the treatment for patients 12 and older with SCD with a history of VOEs

PDUFA Date: December 20, 2023

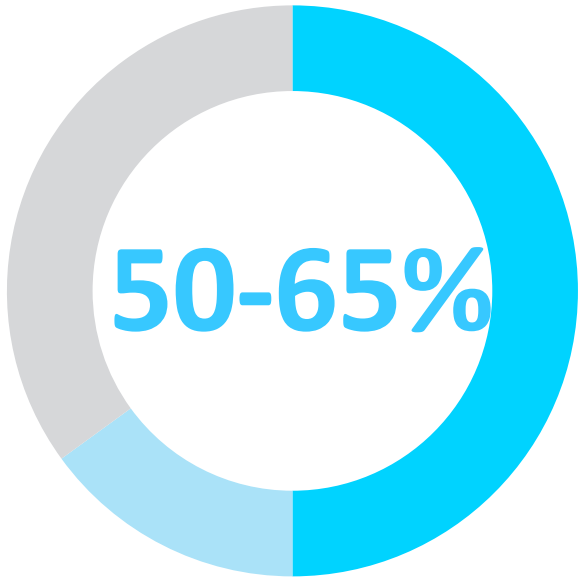
BLA submission includes:

- Efficacy data from 36 patients in HGB-206 Group C
  - Median 32 months of follow up
- Safety data from 50 patients treated across entire lovo-cel program
  - Six patients with ≥ 6 years of follow up
- August 2022 data cut demonstrating:
  - 97% complete resolution of severe VOEs through 24 mos
  - 90% resolution of VOEs through 24 mos
  - Maintenance of VOE resolution in majority of patients through long-term follow up + stable production of HbA
  - Majority of AEs attributed to underlying SCD or conditioning with busulfan

Durability and long-term follow-up are the most important factors driving gene therapy decisions and key differentiators for lovo-cel

…of patients would consider gene therapy if recommended by their doctor

… of physicians are driven by efficacy and long-term follow-up, and not modality



…projected market share for lovo-cel against direct competitors

7+ years of market research consistently underscores lovo-cel as a meaningful treatment option for patients and significant opportunity for bluebird

*Market research conducted by external sources in 2023; Data on file

SKYSONA® for cerebral adrenoleukodystrophy

skysona™
(elivaldogene autotemcel)

Commercial

- 40 potentially eligible patients; anticipate 5–10 patient starts in 2023
- 5 patient starts since launch; 4 QTCs activated; zero ultimate denials across government and commercial payers

Clinical

- 67 patients treated across all clinical trials
- Accelerated approval based on post-hoc analysis of 11 patients; estimated 72% likelihood of major functional disability free survival at 24 months
- Five boys treated in clinical trials developed myelodysplastic syndrome; label includes boxed warning*

SKYSONA is indicated to slow the progression of neurologic dysfunction in boys 4-17 years of age with early, active cerebral adrenoleukodystrophy (CALD)
Patient starts is defined as a cell collection (apheresis); Activated QTC defined as Qualified Treatment Center with a signed MSA
*bluebird closely monitors potential and diagnosed cases of hematologic malignancy in patients treated with SKYSONA and additional cases are expected to arise over time. bluebird is communicating regularly with treating physicians and regulatory authorities.

Upcoming milestones

First to market gene therapy for inherited hemoglobin disorders in the U.S.

SKYSONA® for cerebral adrenoleukodystrophy

- Anticipate 5-10 patient starts in 2023
- Continued launch expansion through 2023

ZYNTEGLO® for beta-thalassemia

- Continued launch expansion through 2023
- 40-50 QTCs by end of 2023

lovo-cel for sickle cell disease

- PDUFA date Dec. 20, 2023
- Commercial launch expected early 2024, if approved

Proving our commercial model → *Significant value driver* →

Potential for significant value creation in the near-term

1. Unique strategic position
2. Strong competitive advantage
3. Focus on profitability


Q + A

thank you