UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 8-K

CURRENT REPORT
Pursuant to Section 13 or 15(d) of The Securities Exchange Act of 1934

Date of Report (Date of Earliest Event Reported): December 5, 2015

bluebird bio, Inc.
(Exact name of registrant as specified in its charter)

DELAWARE	**001-35966**	**13-3680878**
(State or other jurisdiction of incorporation)	(Commission File Number)	(I.R.S. Employer Identification No.)

150 Second Street Cambridge, MA	**02141**
(Address of principal executive offices)	(Zip Code)

Registrant's telephone number, including area code **(339) 499-9300**

Not Applicable

(Former name or former address, if changed since last report)

Check the appropriate box below if the Form 8-K filing is intended to simultaneously satisfy the filing obligation of the registrant under any of the following provisions:

☐ Written communications pursuant to Rule 425 under the Securities Act (17 CFR 230.425)
☐ Soliciting material pursuant to Rule 14a-12 under the Exchange Act (17 CFR 240.14a-12)
☐ Pre-commencement communications pursuant to Rule 14d-2(b) under the Exchange Act (17 CFR 240.14d-2(b))
☐ Pre-commencement communications pursuant to Rule 13e-4(c) under the Exchange Act (17 CFR 240.13e-4(c))

Item 7.01 Regulation FD Disclosure

On December 6, 2015, bluebird bio, Inc. ("bluebird") conducted an investor webcast summarizing clinical data from its Northstar (HGB-204), HGB-205 and HGB-206 clinical trials of its LentiGlobin product candidate and preclinical data relating to its bb2121 product candidate, in each case, presented at the 57th Annual Meeting of the American Society of Hematology in Orlando, Florida from December 5-6, 2015. A copy of the presentation is being furnished as Exhibit 99.4 to this Report on Form 8-K.

The information in Item 7.01 of this Report on Form 8-K and Exhibit 99.4 attached hereto is intended to be furnished and shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934 (the "Exchange Act") or otherwise subject to the liabilities of that section, nor shall it be deemed incorporated by reference in any filing under the Securities Act of 1933 or the Exchange Act, except as expressly set forth by specific reference in such filing.

Item 8.01 Other Events

On December 5, 2015 and December 6, 2015, bluebird issued three press releases announcing clinical data from its Northstar (HGB-204), HGB-205 and HGB-206 clinical trials of its LentiGlobin product candidate and preclinical data relating to its bb2121 product candidate, in each case, presented at the 57th Annual Meeting of the American Society of Hematology in Orlando, Florida from December 5-6, 2015. The full text of bluebird's press releases regarding these announcements is filed as Exhibits 99.1, 99.2, and 99.3 to this Current Report on Form 8-K and is incorporated herein by reference.

Item 9.01 Financial Statements and Exhibits.

(d) Exhibits

Exhibit No.	Description
99.1	Press release issued by bluebird bio, Inc. on December 5, 2015
99.2	Press release issued by bluebird bio, Inc. on December 6, 2015
99.3	Press release issued by bluebird bio, Inc. on December 6, 2015
99.4	Investor presentation provided by bluebird bio, Inc. on December 6, 2015

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned hereunto duly authorized.

Date: December 7, 2015

bluebird bio, Inc.

By:/s/ Jason F. Cole
Jason Cole
Senior Vice President, General Counsel

EXHIBIT INDEX

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99.4	Investor presentation provided by bluebird bio, Inc. on December 6, 2015

Exhibit 99.1

bluebird bio Reports New Beta-thalassemia Major Data from Northstar Study of LentiGlobin® at ASH Annual Meeting

Transfusion independence observed in patients with non-β^0/β^0 genotypes

Transfusion reduction between 33 percent and 100 percent observed in patients with β^0/β^0 genotype

Company to webcast investor event, Sunday, Dec. 6 at 8:30 p.m. ET

ORLANDO, Fla., December 5, 2015 – bluebird bio, Inc. (Nasdaq: BLUE), a clinical-stage company committed to developing potentially transformative gene therapies for severe genetic diseases and T cell-based immunotherapies for cancer, announced that new data from the ongoing Northstar Study evaluating its LentiGlobin® BB305 product candidate in patients with beta-thalassemia major will be presented at the 57th American Society of Hematology Annual Meeting. The data from the Northstar Study will be highlighted on Sunday, December 6th, in an oral presentation by Mark C. Walters, M.D., UCSF Benioff Children's Hospital, Oakland, Calif.

"The growing body of data for LentiGlobin continues to show substantial clinical benefit in patients with beta-thalassemia major, with high levels of HbA^{T87Q} production across patients regardless of genotype," said David Davidson, M.D., chief medical officer, bluebird bio. "Patients with non-β^0/β^0 genotypes represent a large proportion of the population with beta-thalassemia major, and we are particularly encouraged to see the consistency of transfusion independence in all of the patients who have been followed for at least six months. Thus far, the level of transfusion reduction in patients with the β^0/β^0 genotype ranges from 33 percent to 100 percent, indicating the potential for benefit in these patients. In many patients, HbA^{T87Q} levels have not yet plateaued, so further study with longer follow up is needed to fully assess the impact on transfusion requirements in these patients. As we gain a better understanding of the emerging data, we plan to initiate a separate study for patients with the β^0/β^0 genotype, while moving forward with the planned HGB-207 and HGB-208 studies only in patients with non-β^0/β^0 genotypes."

Abstract #201: Update of Results from the Northstar Study (HGB-204): A Phase 1/2 Study of Gene Therapy for β-Thalassemia Major via Transplantation of Autologous Hematopoietic Stem Cells Transduced *Ex Vivo* with a Lentiviral β^{A-T87Q}-Globin Vector (LentiGlobin BB305 Drug Product)

The Northstar Study is an ongoing, open-label, single-dose, international, multicenter Phase 1/2 study designed to evaluate the safety and efficacy of LentiGlobin BB305 drug product for the treatment of subjects with beta-thalassemia major. As of October 28, 2015, 13 subjects with beta-thalassemia major have undergone infusion with LentiGlobin

BB305 product candidate. As of October 28, 2015, nine of these subjects had at least six months follow up. Results in these patients as of October 28, 2015 include:

- Median HbA^{T87Q} production at six months follow up was 4.9 g/dL among patients of all genotypes (n=9), 4.9 g/dL among patients with non-β^0/β^0 genotypes (n=5) and 5.0 g/dL among patients with the β^0/β^0 genotype (n=4).
- All of the patients with non-β^0/β^0 genotypes with at least six months follow up (n=5) have achieved sustained transfusion independence as of the data cut-off, ranging from 7.1 to 16.4 months of ongoing transfusion independence; total hemoglobin at last follow up for these patients ranged from 9.1 to 12.2 g/dL.
- Patients with the β^0/β^0 genotype (n=4) demonstrated a reduction in transfusion volume ranging from 33 percent to 100 percent.
- The safety profile was consistent with autologous transplantation. No Grade 3 or higher drug-product related adverse events have been observed, and there is no evidence of clonal dominance.

“The updated data from the Northstar Study continue to show acceptable patient safety with regard to myeloablation, drug product infusion risks, and genotoxicity at this early follow up,” said Dr. Walters. “All of the subjects treated in the study had a clinical benefit, which was most pronounced in the patients with non-β^0/β^0 genotypes, whose endogenous beta-globin expression combined with HbA^{T87Q} expression was sufficient for transfusion independence. The patients with the β^0/β^0 genotype also had a benefit, with transfusion volume reduction ranging from 33 percent to 100 percent, though longer follow up is needed to understand the clinical significance of this data. The results of the Northstar Study to date suggest that it is safe, feasible and potentially efficacious to treat patients with beta-thalassemia major with LentiGlobin BB305.”

Investor Webcast Information

bluebird bio will host an investor event that will be webcast live at 8:30 p.m. ET tomorrow, December 6, 2015, to discuss the ASH data and provide a brief overview of the science and clinical development plans surrounding the gene therapy, genome editing and immunotherapy programs. The live webcast can be accessed under "Calendar of Events" in the Investors and Media section of the company's website at www.bluebirdbio.com. The webcast will be available for replay for 30 days on the company website. Alternatively, investors may listen to the call by dialing (844) 825-4408 from locations in the United States or (315) 625-3227 from outside the United States. Please refer to conference ID number 71438159.

About bluebird bio, Inc.
With its lentiviral-based gene therapies, T cell immunotherapy expertise and gene editing capabilities, bluebird bio has built an integrated product platform with broad potential application to severe genetic diseases and cancer. bluebird bio’s gene therapy clinical

programs include its Lenti-D™ product candidate currently in a Phase 2/3 study, called the Starbeam Study, for the treatment of childhood cerebral adrenoleukodystrophy, and its LentiGlobin® BB305 product candidate, currently in three clinical studies for the treatment of beta-thalassemia major and severe sickle cell disease. bluebird bio's oncology pipeline is built upon the company's leadership in lentiviral gene delivery and T cell engineering, with a focus on developing novel T cell-based immunotherapies, including chimeric antigen receptor (CAR T) and T cell receptor (TCR) therapies. bluebird bio's lead oncology program, bb2121, is an anti-BCMA CAR T program partnered with Celgene and focused on hematologic malignancies. bluebird bio also has discovery research programs utilizing megaTALs/homing endonuclease gene editing technologies with the potential for use across the company's pipeline.

bluebird bio has operations in Cambridge, Massachusetts, Seattle, Washington, and Paris, France.

LentiGlobin and Lenti-D are trademarks of bluebird bio, Inc.

Forward-Looking Statements

This release contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995, including statements regarding the potential efficacy and safety of the Company's LentiGlobin BB305 product candidate in subjects with beta thalassemia major, including statements concerning the production of HbAT87Q and the reduced or eliminated need for transfusion support for the study subjects with beta thalassemia major, statements concerning the Company's future plans with respect to LentiGlobin and its other product candidates. It should be noted that the data announced for LentiGlobin are preliminary in nature and the Northstar study of LentiGlobin is not complete. There is limited data concerning long-term safety and efficacy following treatment with LentiGlobin. These data may not continue for these subjects or be repeated or observed in ongoing or future studies involving our LentiGlobin product candidate, including the HGB-205 Study, the Northstar Study or the HGB-206 study in severe sickle cell disease. It is possible that subjects for whom transfusion support has been reduced or eliminated may receive transfusion support in the future. Any forward-looking statements are based on management's current expectations of future events and are subject to a number of risks and uncertainties that could cause actual results to differ materially and adversely from those set forth in or implied by such forward-looking statements. These risks and uncertainties include, but are not limited to, the risk that the preliminary results from our clinical trials will not continue or be repeated in our ongoing clinical trials, the risk that previously conducted studies involving similar product candidates will not be repeated or observed in ongoing or future studies involving current product candidates, the risk of cessation or delay of any of the ongoing or planned clinical studies and/or our development of our product candidates, the risk of a delay in the enrollment of patients in our clinical studies, and the risk that any one or more of our product candidates will not be successfully developed and commercialized. For a discussion of other risks and uncertainties, and other

important factors, any of which could cause our actual results to differ from those contained in the forward-looking statements, see the section entitled "Risk Factors" in our most recent quarterly report on Form 10-Q, as well as discussions of potential risks, uncertainties, and other important factors in our subsequent filings with the Securities and Exchange Commission. All information in this press release is as of the date of the release, and bluebird bio undertakes no duty to update this information unless required by law.

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Exhibit 99.2

bluebird bio Reports New Beta-thalassemia Major and Severe Sickle Cell Disease Data from HGB-205 and HGB-206 Studies of LentiGlobin® at ASH Annual Meeting

Two patients with beta-thalassemia major with β^{0}/β^{E} genotype remain transfusion-independent for 23.4 and 20.1 months, respectively

Patient with severe sickle cell disease (SCD) in HGB-205 study remains free of transfusions and complications from SCD for nine months and is producing 49 percent anti-sickling hemoglobin

Early safety data presented from patients with severe SCD treated in HGB-206 study

Company to webcast investor event, Sunday, December 6 at 8:30 p.m. ET

ORLANDO, Fla., December 6, 2015 – bluebird bio, Inc. (Nasdaq: BLUE), a clinical-stage company committed to developing potentially transformative gene therapies for severe genetic diseases and T cell-based immunotherapies for cancer, announced the presentation of new data from the ongoing HGB-205 and HGB-206 clinical studies evaluating its LentiGlobin BB305 product candidate in patients with beta-thalassemia major and severe sickle cell disease (SCD), at the 57th American Society of Hematology Annual Meeting.

The data from the HGB-205 study were highlighted today in an oral presentation by Marina Cavazzana, M.D., Ph.D., lead investigator of the HGB-205 study and professor of hematology at Paris Descartes University, head of the department of Biotherapy Hospital, the clinical research INSERM center of Biotherapy at Necker Enfants Malades, (Assistance Publique-Hôpitaux de Paris) and the Lymphohematopoiesis Laboratory, Institute of Genetic Diseases, Imagine, Paris, France. Data from the HGB-206 study were presented today during a poster session by John F. Tisdale, M.D., senior investigator, molecular and clinical hematology branch at the National Institutes of Health.

“The data from the HGB-205 and HGB-206 studies further demonstrate the potential for gene therapy to make a meaningful and enduring difference in the lives of patients with beta-thalassemia major or severe SCD,” said David Davidson, M.D., chief medical officer, bluebird bio. “We are especially encouraged by the data from the HGB-205 study, which is demonstrating stable clinical benefit in patients with beta-thalassemia major and includes data from the first patient with severe SCD ever treated with gene therapy, now with a year of follow up. The data from the HGB-206 study are still very early, and we look forward to gaining greater clarity on the therapeutic profile of LentiGlobin in severe SCD as we treat more patients and obtain longer follow up in the coming year.”

Abstract #202: Outcomes of Gene Therapy for Severe Sickle Disease and Beta-Thalassemia Major Via Transplantation of Autologous Hematopoietic Stem Cells Transduced Ex Vivo with a Lentiviral βA-T87Q -Globin Vector (HGB-205 study)

HGB-205 is an ongoing, open-label, single-center Phase 1/2 study designed to evaluate the safety and efficacy of LentiGlobin BB305 drug product in the treatment of patients with beta-thalassemia major and severe SCD. As of November 10, 2015, four subjects with beta-thalassemia major and one subject with severe SCD have undergone infusion with LentiGlobin BB305 product candidate in this study. Results as of November 10, 2015, include:

- Subject 1201 with the β^0/β^E genotype of beta-thalassemia major has 23.4 months of transfusion independence with total hemoglobin of 10.8 g/dL, of which 7.9 g/dL was HbA^{T87Q}. Subject 1202 with the β^0/β^E genotype of beta-thalassemia major has 20.1 months of transfusion independence with total hemoglobin of 13.1 g/dL, of which 10.3 g/dL was HbA^{T87Q}.
- An additional two patients with beta-thalassemia major, Subjects 1203 and 1206, have been infused, though it is too early to draw any meaningful efficacy conclusions. At their most recent follow ups, three months and one month, respectively, these patients were producing measurable levels of HbA^{T87Q}, which are steadily increasing in Subject 1203.
- At the 12-month post-drug infusion follow up for Subject 1204 with severe SCD, the proportion of anti-sickling hemoglobin (HbA^{T87Q} + HbF) accounted for 49 percent of all hemoglobin production (47 percent HbA^{T87Q} + 2 percent HbF) – well above the 30 percent threshold expected to potentially achieve a disease-modifying clinical effect. Prior to infusion, Subject 1204 required chronic blood transfusions; he was successfully weaned off of transfusions and has remained transfusion independent for more than nine months. Since infusion, this patient has had no hospitalizations or acute SCD-related events.
- No LentiGlobin-related adverse events have been observed; all of the adverse events observed are consistent with myeloablative conditioning.
- All five treated subjects successfully engrafted and insertional site analyses (ISAs) demonstrate highly polyclonal reconstitution without clonal dominance.

“These data are evidence of the durable responses we have seen in patients with beta-thalassemia major or severe SCD who have received a one-time treatment with LentiGlobin,” said Professor Cavazzana. “We are now seeing the benefit of gene therapy with LentiGlobin beyond one year in two patients with beta-thalassemia major. Clinical benefit continues to be realized in the patient with severe SCD after 12 months of follow up. We are encouraged by these results and the potential benefit treatment with LentiGlobin can have on patients living with these debilitating diseases.”

Abstract #3233: Initial Results from Study HGB-206: A Phase 1 Study Evaluating Gene Therapy by Transplantation of Autologous CD34+ Stem Cells Transduced *Ex Vivo* with the LentiGlobin BB305 Lentiviral Vector in Subjects with Severe Sickle Cell Disease (HGB-206 study)

HGB-206 is an ongoing, open-label Phase 1 study designed to evaluate the safety and efficacy of LentiGlobin BB305 product candidate in the treatment of subjects with severe SCD. Results, as of November 17, 2015, include:

- Drug product has been manufactured for four patients with severe SCD, and three patients have been infused with LentiGlobin BB305. Subjects 1301 and 1303 have three and 5.3 months of follow up post-infusion, respectively.
- Drug product vector copy number (VCN) was 0.5/0.6 in Subject 1301, 1.3 in Subject 1303 and 0.6 in Subject 1306.
    - VCN in peripheral blood leukocytes at three months follow up was 0.04 in Subject 1301 and 0.11 in Subject 1303.
- Early data on Subjects 1301 and 1303 with at least three months of follow up show a gradual increase in HbA^{T87Q} levels post-infusion.
    - At the three-month post-infusion follow up for Subject 1301, the proportion of anti-sickling hemoglobin accounted for 17 percent of all hemoglobin production (4 percent HbA^{T87Q} + 13 percent HbF).
    - At the six-month post-infusion follow up for Subject 1303, the proportion of anti-sickling hemoglobin accounted for 16 percent of all hemoglobin production (12 percent HbA^{T87Q} + 4 percent HbF).
    - Longer follow up data and additional subjects are required to determine the extent of HbA^{T87Q} production and clinical benefit of LentiGlobin BB305 in severe SCD.
- The safety profile in the infused patients is consistent with autologous transplantation and no drug product-related grade $\geq$3 adverse events have been reported.

Investor Webcast Information

bluebird bio will host an investor event that will be webcast live at 8:30 p.m. ET today, December 6, 2015, to discuss the ASH data and provide a brief overview of the science and clinical development plans surrounding the gene therapy, genome editing and immunotherapy programs. The live webcast can be accessed under "Calendar of Events" in the Investors and Media section of the company's website at www.bluebirdbio.com. The webcast will be available for replay for 30 days on the company website. Alternatively, investors may listen to the call by dialing (844) 825-4408 from locations in the United States or (315) 625-3227 from outside the United States. Please refer to conference ID number 71438159.

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development of our product candidates, the risk of a delay in the enrollment of patients in our clinical studies, and the risk that any one or more of our product candidates will not be successfully developed and commercialized. For a discussion of other risks and uncertainties, and other important factors, any of which could cause our actual results to differ from those contained in the forward-looking statements, see the section entitled "Risk Factors" in our most recent quarterly report on Form 10-Q, as well as discussions of potential risks, uncertainties, and other important factors in our subsequent filings with the Securities and Exchange Commission. All information in this press release is as of the date of the release, and bluebird bio undertakes no duty to update this information unless required by law.

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Exhibit 99.3

bluebird bio Presents Pre-Clinical and Manufacturing Data from CAR T Oncology Programs at ASH Annual Meeting

Company to webcast investor event, Sunday, December 6 at 8:30 p.m. ET

ORLANDO, Fla., December 6, 2015 – bluebird bio, Inc. (Nasdaq: BLUE), a clinical-stage company committed to developing potentially transformative gene therapies for severe genetic diseases and T cell-based immunotherapies for cancer, announced that pre-clinical data from its anti-BCMA oncology program were presented by bluebird bio scientists at the 57th American Society of Hematology Annual Meeting.

"We believe the unique science and translational gene therapy platforms we have built differentiate bluebird bio in the oncology field and have the potential to yield important new therapies for patients living with cancer. Our three oncology posters at ASH this year, covering critical basic research, translational and manufacturing aspects of our T cell oncology pipeline, demonstrate the strength of our T cell immunotherapy translational science," said Rob Ross, M.D., head of oncology, bluebird bio. "We are also excited to see the first anti-BCMA clinical data from Dr. Jim Kochenderfer of the National Cancer Institute, which was highlighted in yesterday's press release from ASH. We believe these data provide excellent proof of concept for bb2121 and are pleased that Jim will serve as one of the principal investigators for our Phase 1 study of bb2121."

Abstract #1893: Manufacturing an Enhanced CAR T Cell Product by Inhibition of the PI3K/Akt Pathway During T Cell Expansion Results in Improved *In Vivo* Efficacy of Anti-BCMA CAR T Cells

Overview and results, presented by Molly Perkins, D.Phil., bluebird bio, include:

- bluebird bio explored the potential for culture modifications to improve the therapeutic potential of CAR T cells without adding complexity to manufacturing. The company tested this hypothesis using CAR T cells specific to B cell maturation antigen (BCMA) manufactured using standard IL-2 culture with an inhibitor of PI3K added to the media, or with IL-7 and IL-15, in place of IL-2.
- In an *in vivo* aggressive lymphoma model, mice treated with anti-BCMA CAR T cells cultured only with IL-2 experienced no effect on tumor growth and succumbed to the tumors within two weeks after treatment; anti-BCMA CAR T cells grown in IL-7 and IL-15 also did not affect tumor growth. In contrast, mice treated with anti-BCMA CAR T cells cultured with IL-2 and an inhibitor of PI3K experienced complete and long-term tumor regression.
- In an *in vivo* multiple myeloma model, mice received a single administration of anti-BCMA CAR T cells cultured under various conditions; all treatment groups

demonstrated tumor regression regardless of culture conditions. In a model of tumor relapse, two weeks after tumor clearance, surviving mice were re-challenged with the same multiple myeloma tumors on the opposite flank; only animals that had been treated with anti-BCMA CAR T cells cultured with the PI3K inhibitor were able to resist subsequent tumor challenge.

- These data suggest that inhibition of PI3K during *ex vivo* expansion may generate a superior anti-BCMA CAR T cell product for clinical use; this approach could potentially apply to the manufacture of CAR T cell therapies against other oncology targets.

Abstract #3094: A Novel and Highly Potent CAR T Cell Drug Product for Treatment of BCMA-Expressing Hematological Malignancies

Overview and results, presented by Alena Chekmasova, Ph.D., bluebird bio, include:

- bluebird bio has developed a CAR targeting BCMA (bb2121) that consists of an extracellular single chain variable fragment scFv antigen recognition domain derived from antibodies to BCMA linked to CD137 (4-1BB) co-stimulatory and CD3zeta chain signaling domains.
- Based on receptor density quantification, bb2121 can recognize tumor cells expressing less than 1,000 BCMA molecules per cell.
- In a preclinical BCMA+ multiple myeloma xenograft model, a single IV administration of bb2121 anti-BCMA CAR T cells resulted in rapid and sustained elimination of the tumors with 100 percent survival, while a month-long course of anti-myeloma therapy Velcade® (bortezomib) only delayed tumor growth.
- Using flow cytometry and immunohistochemistry, bb2121 T cells were shown to rapidly target and infiltrate tumors, and T cell expansion was correlated with tumor regression.
- bb2121 anti-BCMA CAR T cells also induced xenograft regression and enhanced survival in a preclinical model of advanced Burkitt's lymphoma.
- Taken together, these studies support the potential clinical application of bb2121 for the treatment of patients with tumors expressing BCMA.

Abstract #3243: Characterization of Lentiviral Vector Derived Anti-BCMA CAR T Cells Reveals Key Parameters for Robust Manufacturing of Cell-Based Gene Therapies for Multiple Myeloma

Overview and results, presented by Graham W.J. Lilley, M.Sc., bluebird bio, include:

- Successful personalized medicine will require robust and reproducible drug product manufacturing. A series of experiments were conducted to determine whether variations in anti-BCMA CAR surface expression resulted in changes in the activity of CAR T cells.
- T cells transduced with varying amounts of virus to yield different amounts of CAR surface expression were diluted with donor-matched untransduced cells to

achieve a uniform population of T cells containing 26 ± 4 percent anti-BCMA CAR T cells. When exposed to tumor, these CAR T cell populations exhibited no difference in cytotoxicity against BCMA-expressing cells.

- All T cell productions easily achieved a level of anti-BCMA CAR expression that resulted in potent anti-BCMA activity, thus potency of the final drug product was shown to be independent of total anti-BCMA CAR expression on the cell surface.
- These data show that the bluebird bio T cell manufacturing process has the potential to overcome significant challenges associated with personalized medicine by reducing the effects of variability while maintaining potency in autologous cellular drug product manufacturing.

Investor Webcast Information

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bluebird bio has operations in Cambridge, Massachusetts, Seattle, Washington, and Paris, France.

Forward-Looking Statements

This release contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995, including statements regarding the clinical potential and manufacturing of the Company's anti-BCMA oncology program, including its bb2121 product candidate. Any forward-looking statements are based on management's current expectations of future events and are subject to a number of risks and uncertainties that could cause actual results to differ materially and adversely from those set forth in or implied by such forward-looking statements. These risks and uncertainties include, but are not limited to, the risk that the preclinical efficacy and safety data for our bb2121 product candidate will not be observed in our planned clinical studies, the risk of cessation or delay of any of the ongoing or planned clinical studies and/or our development of our product candidates, the risk of a delay in the enrollment of patients in our clinical studies, the risk that our collaboration with Celgene Corporation will not continue or will not be successful, and the risk that any one or more of our product candidates will not be successfully developed and commercialized. For a discussion of other risks and uncertainties, and other important factors, any of which could cause our actual results to differ from those contained in the forward-looking statements, see the section entitled "Risk Factors" in our most recent quarterly report on Form 10-Q, as well as discussions of potential risks, uncertainties, and other important factors in our subsequent filings with the Securities and Exchange Commission. All information in this press release is as of the date of the release, and bluebird bio undertakes no duty to update this information unless required by law.

Contact:
bluebird bio, Inc.
Manisha Pai, 617-245-2107
mpai@bluebirdbio.com
or
Pure Communications, Inc.
Dan Budwick, 973-271-6085

Exhibit 99.4


bluebirdbio®
Making Hope a Reality
Transforming the Lives of Patients
with Severe Genetic and Rare Diseases
Nasdaq : BLUE

Forward Looking Statement

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, and the timing or likelihood of regulatory filings and approvals 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.

Nasdaq: BLUE

Tonight's Agenda

Time Slot (EST)	Topic	Speaker
8:00 – 8:30 p.m.	Cocktail Reception	
8:30 – 8:35 p.m.	Welcome, Forward Looking Statements & Agenda	Jim DeTore, *chief financial officer*
	Opening Remarks	Nick Leschly, *chief bluebird*
8:35 – 9:05 p.m.	**TOPIC 1: HSC Program Updates & Review of ASH Data**	
	Beta-thalassemia Major	David Davidson, M.D., *chief medical officer*
	Sickle Cell Disease	David Davidson, M.D., *chief medical officer*
9:05 – 9:20 p.m.	**TOPIC 2: Research Platform**	
	Platform Improvements	Philip Gregory, D. Phil, *chief scientific officer*
	Genome Editing	Philip Gregory, D. Phil, *chief scientific officer*
9:20 – 9:35 p.m.	**TOPIC 3: Immuno-oncology Overview & Review of ASH Data**	
	BCMA Preclinical Data	Richard Morgan, Ph.D., *vice president, immunotherapy*
	BCMA Clinical Program	Rob Ross, M.D., *head of oncology*
9:35 –10:00 p.m.	**WRAP UP AND Q&A**	
	Closing Remarks	Nick Leschly, *chief bluebird*
	Q&A	All Presenters

bluebird bio: Why We Do What We Do

Ethan

Aidan

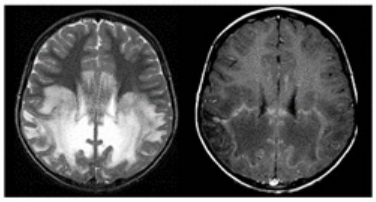
Cameron

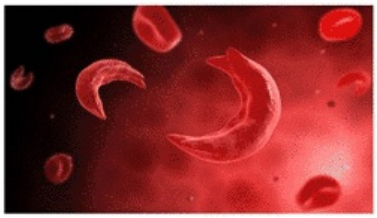
Our Vision – Make Hope a Reality

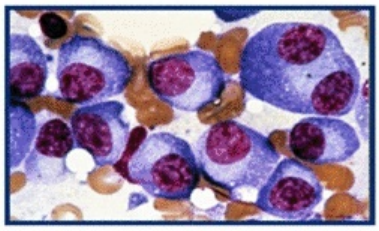
Seeking to transform the lives of patients with severe genetic and rare diseases through the development of innovative gene therapy products.

It's More Than Biology…

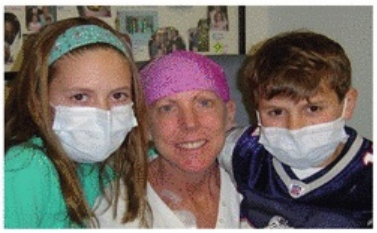
Figure 1: Inflammatory demyelination seen in cerebral ALD (left: T2 image, right: post gadolinium).



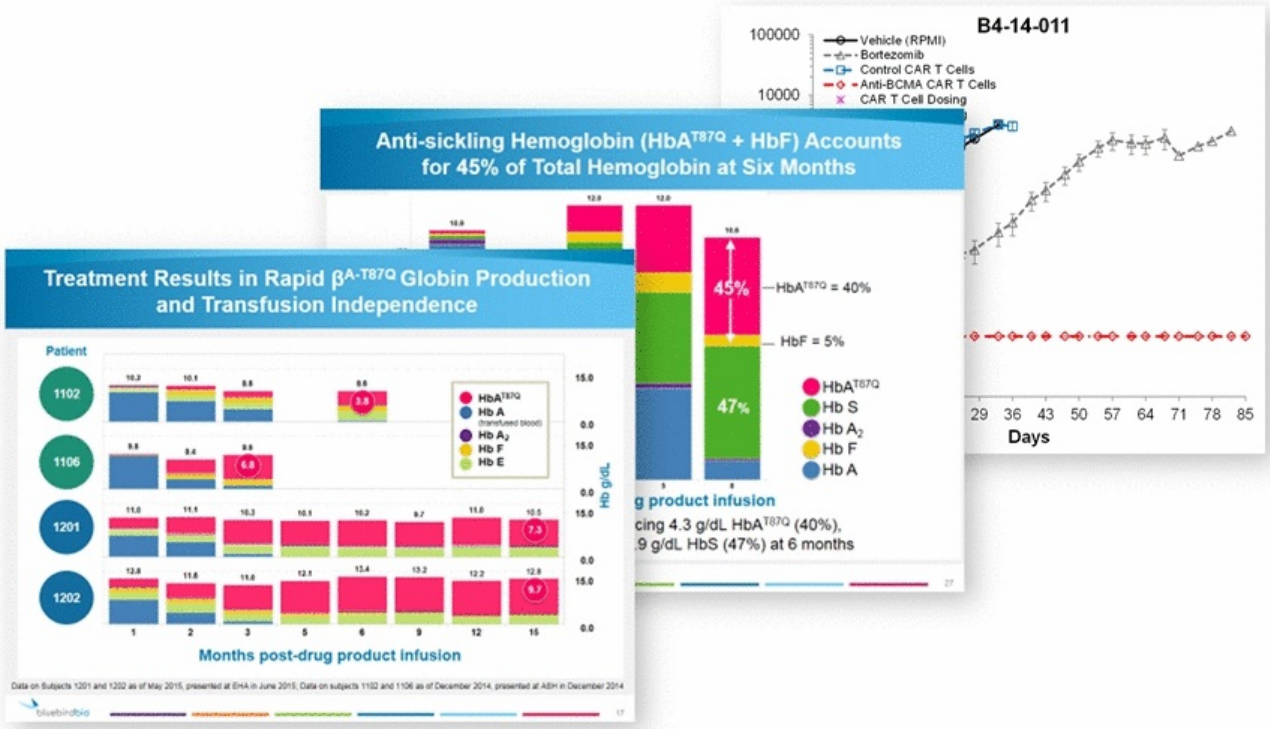




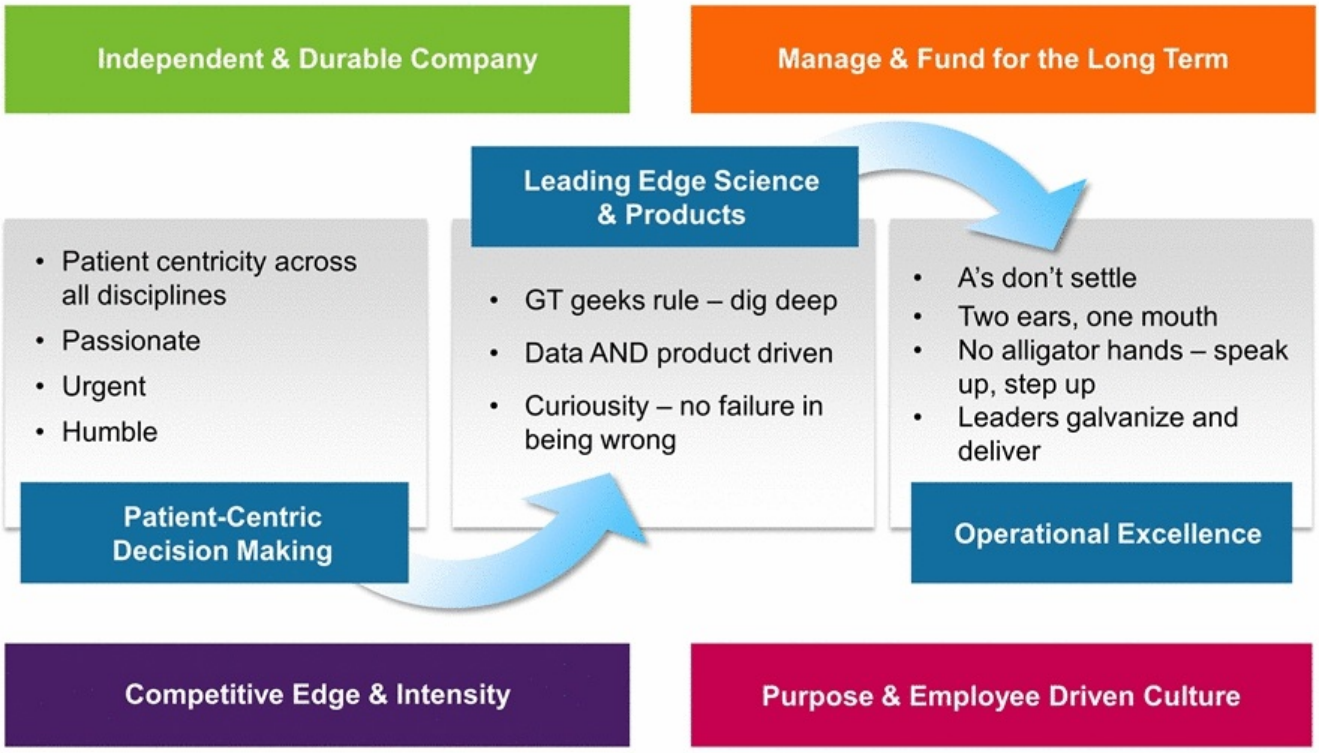
Multiple Myeloma Plasma Cells



TRUE BLUE Gaining Momentum…



What is Our Mindset?



The Innovators Dilemma

"DOWNSIDE RISK OF SUCCESS IS CHOICE"

DOWNSIDE
RISK & FEAR

UPSIDE
OPTIMISM & HUNGER

***Dissatisfied Optimists** (and Paranoid)*

Ecosystem Explosion
Competition Great For All (Especially Patients)

Deepening Pipeline

Product Candidates	Program Area	Preclinical	Phase 1/2	Phase 2/3	Rights/Partner
	CNS Diseases				
Lenti-D™	Childhood Cerebral ALD				Worldwide
	Rare Hemoglobinopathies				
LentiGlobin®	Beta-thalassemia Major*				Worldwide
	Severe Sickle Cell Disease				Worldwide
	Oncology				
bb2121 BCMA	Multiple Myeloma				Celgene
Next Gen BCMA	Multiple Myeloma				Celgene
Five Prime Target	Undisclosed				Worldwide
HPV-16 E6 TCR	HPV-associated Cancers				Kite Pharma
Viromed Target	Undisclosed				Worldwide excluding Korea
Other Programs	Undisclosed				Worldwide
	Research				
Early Pipeline	Undisclosed + Gene Editing				Worldwide

* The current clinical trials for LentiGlobin are Phase 1/2 studies that may provide the basis for early conditional approval in some jurisdictions

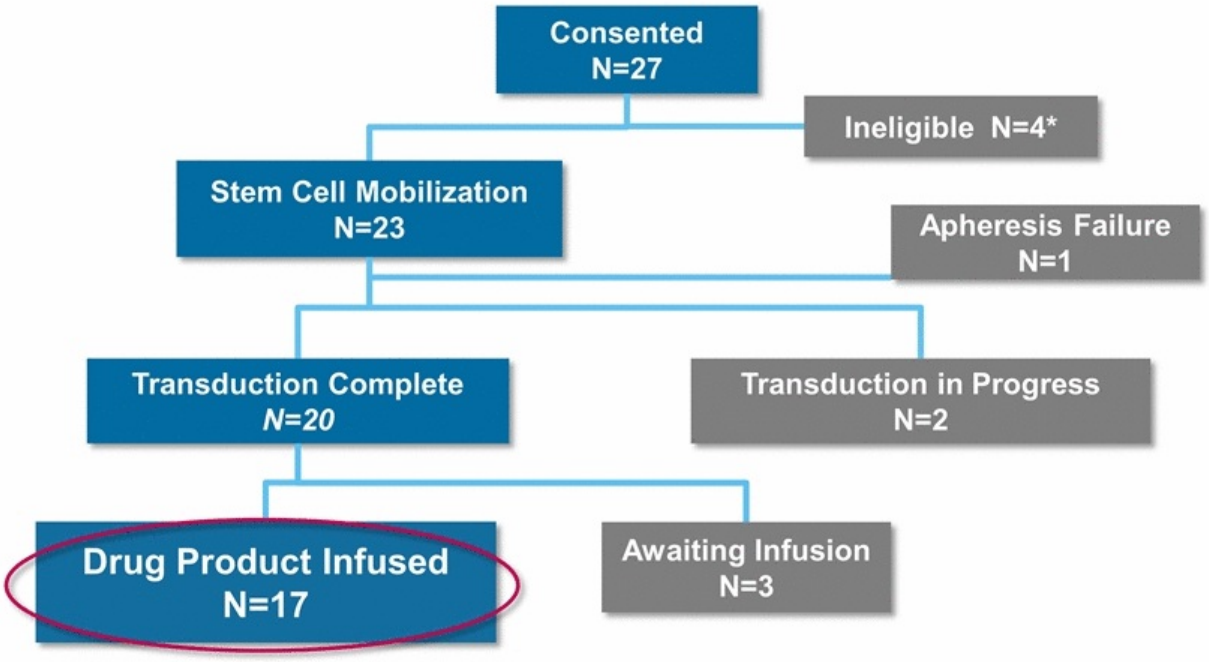
Asking the Important Questions

- What is the β-thalassemia clinical/regulatory path forward?
- What is the SCD data telling us?
- What are you doing to improve your platform?
- What are you doing to build a sustainable pipeline?
- What is the plan for oncology/BCMA?


bluebirdbio®
LentiGlobin Clinical Data Update
Dave Davidson, M.D.
Chief Medical Officer
Nasdaq : BLUE

β-thalassemia Major

HGB-204 and HGB-205 β-Thalassemia Subjects



*reasons for ineligibility: advanced liver disease (n=3), positive HBV serology (n=1)
As of October 28, 2015

Demographics for Treated Patients with β-Thalassemia Major

Parameter	Category	HGB-204 (N=13)	HGB-205 (N=4)	Total (N= 17)
Gender (n)	M	2	2	4
	F	11	2	13
Age (yrs)	Median (range)	21 (18-35)	18 (16-19)	20 (16-35)
Genotype (n)	β0/β0	6	0	6
	β0/βE	4	3	7
	β0/β+	1	0	1
	β+/β+	1	1	2
	β0/βx	1	0	1
Pre-study pRBC transfusion requirements (ml/kg/year)	Median (range)	168 (131-233)	182 (139-197)	172 (131-233)
Splenectomized (n)	Yes	5	3	8
Drug Product VCN	Median (range)	0.7 (0.3-1.5)	1.3 (0.8-2.1)	0.8 (0.3-2.1)
Drug product dose (CD34x10^6 cells/kg)	Median (range)	8.1 (5.2-14.0)	10.5 (8.8-13.6)	8.9 (5.2-14.0)

Data as of 28 Oct 2015; Data reported from an ongoing trial with an open database

Safety Profile: No Drug Product-Related Serious Adverse Events

Incidence of non-hematologic Grade 3-4 AEs, by PT Occurring in ≥ 2 subjects		
	HGB-204 n (%)	HGB-205 n (%)
Number of subjects	13	4
Stomatitis	9 (69%)	3 (75%)
Febrile Neutropenia	7 (54%)	0
Pharyngeal inflammation	4 (31%)	0
Irregular Menses	2 (15%)	0

- All AEs consistent with busulfan myeloablative conditioning
- Single Grade 1 DP-related AE (flushing)
- 4 SAEs post-Drug Product Infusion, none related:
  - G3 Wisdom tooth infection
  - G2 Catheter-related thrombosis
  - G3 Veno-occlusive liver disease
  - G3 Skin infection

Data as of 01 Oct 2015
Data reported from an ongoing trial with an open database

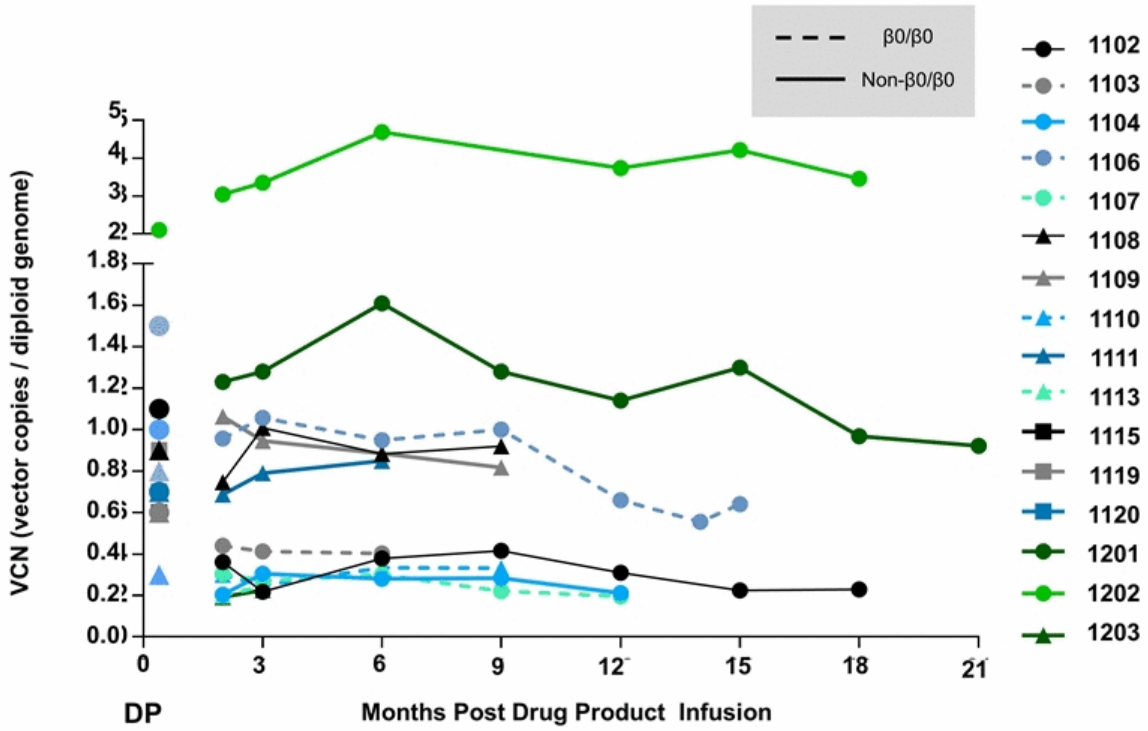
Engraftment and LVV-Specific Safety

	HGB-204	HGB-205
Follow-up period (months)	Median 9 (n = 13) (range 0.2 – 19.1)	Median 11.4 (n = 4) (range 1.8 – 21)
Neutrophil engraftment	Median Day +18 (n = 11) (range 13 - 29)	Median Day +16 (n = 4) (range 13 – 28)
Platelet engraftment	Median Day +30 (n = 10) (range 17 - 39)	Median Day +21 (n = 4) (range 17 – 24)

- No replication competent lentivirus detected
- Integration site analysis shows highly polyclonal repopulation with no clonal dominance detected at any time point
  - HGB-204: Median of 560 (range 190-2,888) unique integration sites per subject at latest time point (3 to 12 months)
  - HGB-205: Subjects 1201 and 1202 with 756 and 8685 unique integration sites at 12 months, respectively

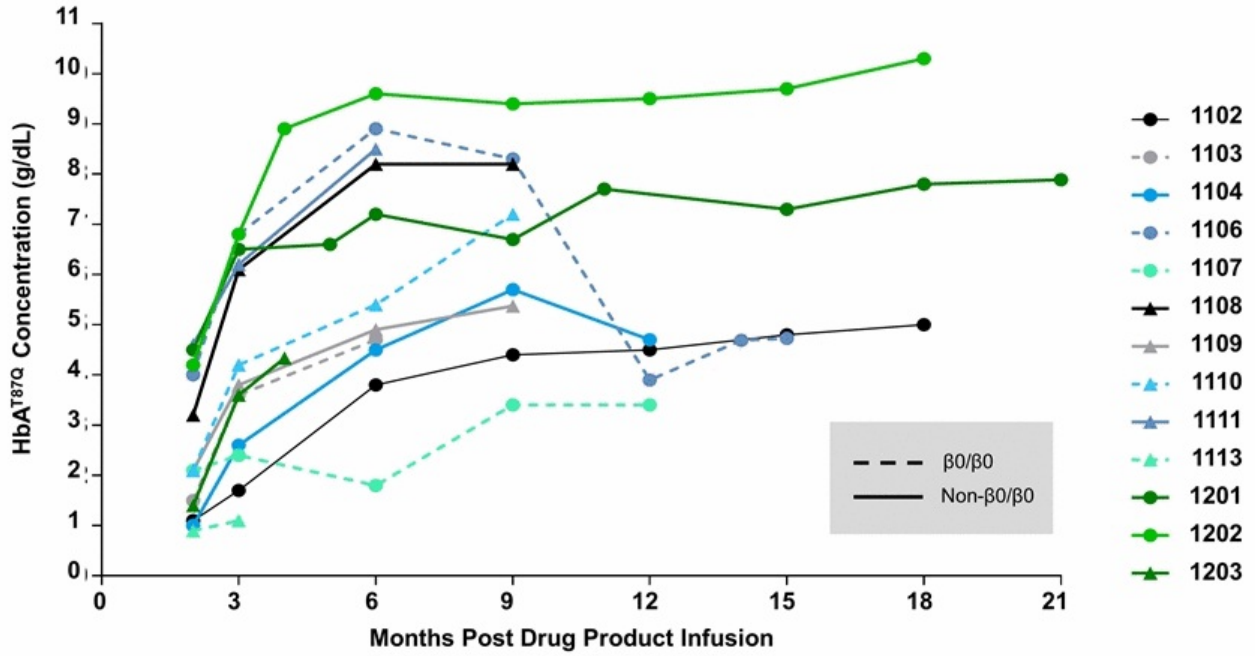
Data as of 01 Oct 2015
Data reported from an ongoing trial with an open database

Drug Product VCN and VCN in Peripheral Blood Leukocytes After Infusion



As of October 28, 2015. DP VCN for all treated subjects. PBL VCN given for subjects with ≥2 months follow-up

HbA^{T87Q} Production After Infusion

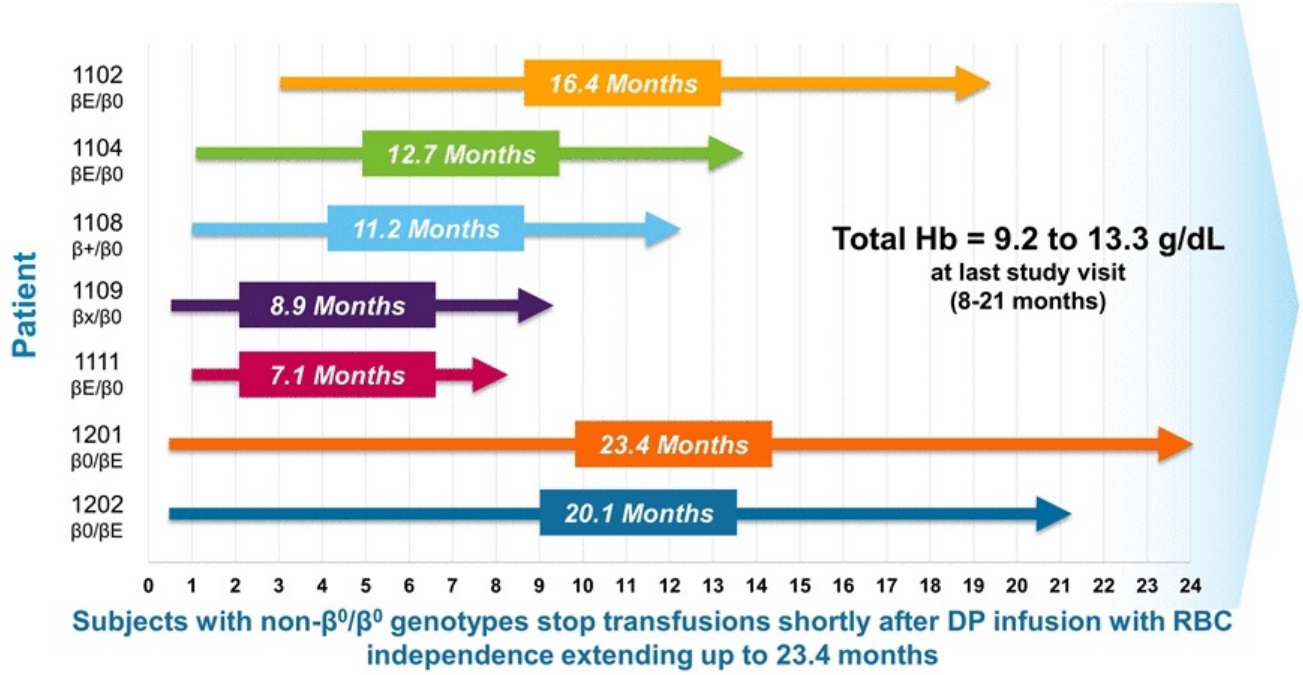


Median HbA^{T87Q} g/dL	**3.8** N=13	**5.4** N=11	**6.7** N=9	**4.4** N=5	**6.1** N=4	**7.8** N=3

As of October 28, 2015. Only includes subjects with ≥3 months of follow-up

Ongoing Transfusion Independence in Patients with Non-β^0/β^0 Genotypes with at Least 6 Months Follow Up

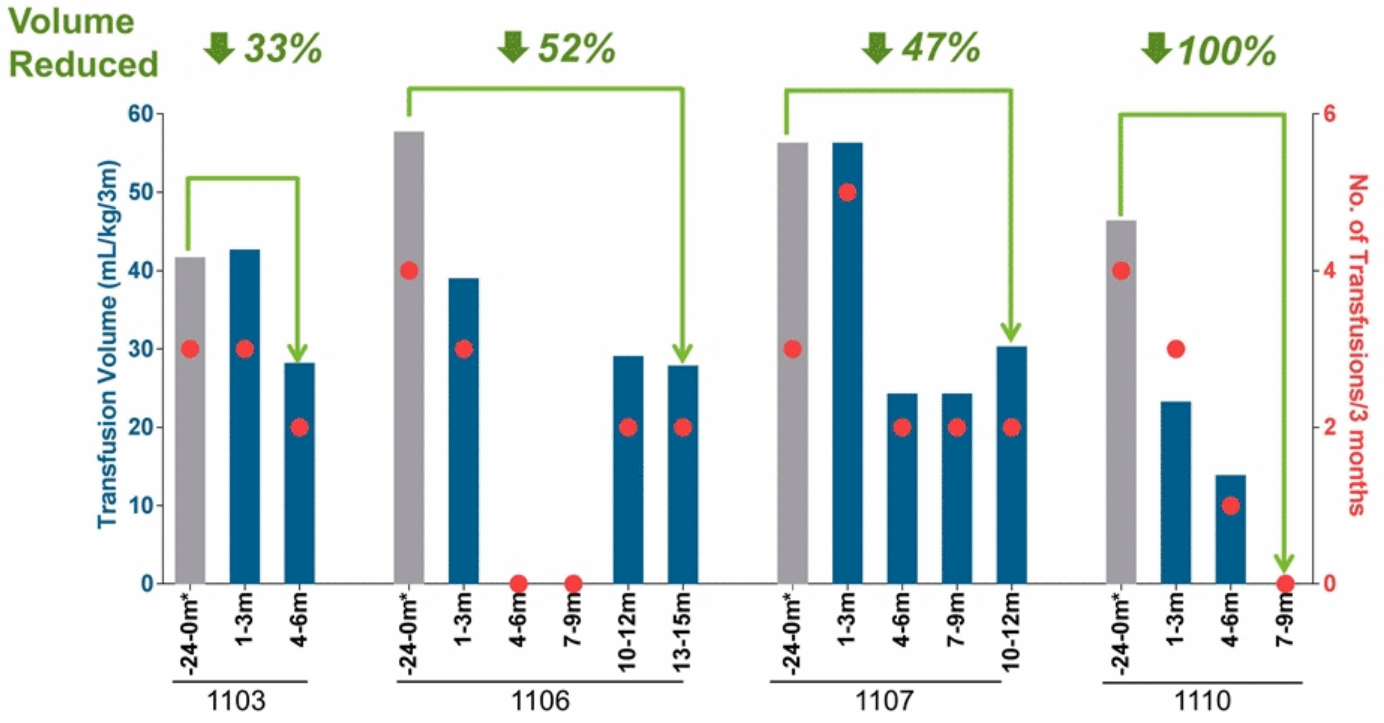
Months Transfusion-Free*



Subjects with non-β^0/β^0 genotypes stop transfusions shortly after DP infusion with RBC independence extending up to 23.4 months

*as of October 28, 2015 for patients in HGB-204 and November 10, 2015 for patients in HGB-205

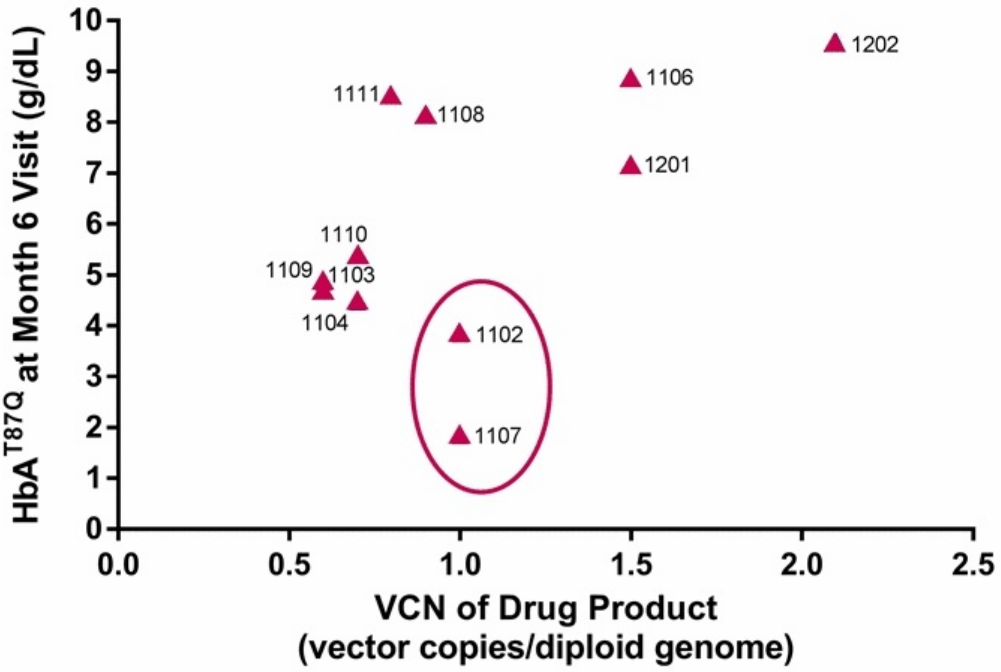
33% to 100% Reduction in pRBC Transfusions Observed in Subjects with β0/β0 Genotype



*3-month average number and number of pRBC transfusions over 12 months prior to infusion

As of October 28, 2015. Subjects with ≥6 m follow-up, shown to latest 3m interval, as of data cut-off. Subjects 1113 & 1115 had <6m follow-up.

Effect of Drug Product VCN on HbA^{T87Q} Expression



Evolving Clinical and Regulatory Plans

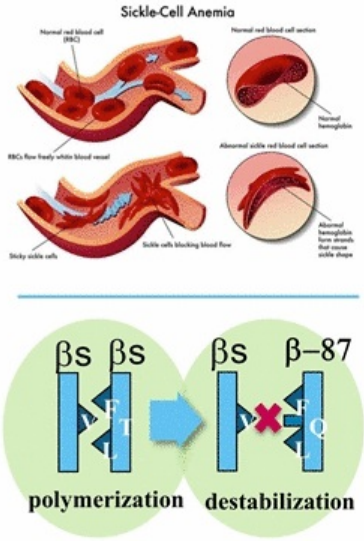
- Initial U.S. regulatory strategy will focus on non-β0/β0 patients
- HGB-207 and likely HGB-208 to enroll only non-β0/β0 patients
- Collecting more data on β0/β0 patients to finalize development path in this genotype, including EU regulatory strategy

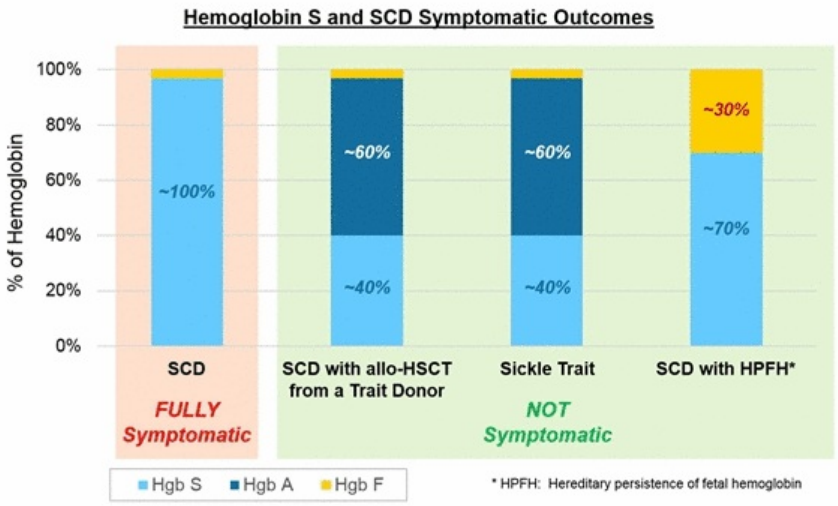
EU	Pursue **CONDITIONAL APPROVAL** on the basis of data from ongoing Northstar (HGB-204) & HGB-205 studies
U.S.	Pursue **ACCELERATED APPROVAL** on the basis of data from planned pivotal HGB-207 & HGB-208 studies

Severe Sickle Cell Disease

Why LentiGlobin May Treat Sickle Cell Disease

LentiGlobin incorporates anti-sickling amino acid found in fetal hemoglobin (glutamine at position 87)





These data suggest that as little as 3g/dL (~30%) of anti-sickling hemoglobin could be functionally curative

HGB-206 Enrollment Update

HGB-206
(Severe sickle cell disease)

Patients with severe sickle cell disease
Open label, multi-center, U.S. based study

- Increased enrollment target from 8 subjects to 20 subjects to provide additional data and flexibility for regulatory strategy
- As of November 17, 2015, 11 subjects enrolled; bone marrow harvest completed for four subjects and in progress for five subjects
- Primary endpoint = Safety of gene therapy among patients with severe SCD
- Secondary endpoints = clinical events, including vaso-occlusive crises or acute chest syndrome

Severe Sickle Cell Disease
Treated Patient Demographics

Parameter	HGB-205	HGB-206		
	1204	1301	1303	1306
Gender	M	F	M	M
Age at enrollment (years)	13	25	42	20
Time since BB305 infusion	13.0 m	3.0 m	5.3 m	<1 m
SCD Disease History				
Vaso-occlusive crisis	Y	Y	Y	Y
Acute chest syndrome	Y	Y	Y	Y
Tricuspid regurgitant jet velocity (TRJV) >2.5 m/s			Y	
Drug product dose ($CD34x10^6$ cells/kg)	5.6	2.6	2.8	2.1
Drug Product VCN	1.0/1.2	0.5/0.6	1.3	0.6

Data as of 10 Nov 2015 (HGB-205) / 17 Nov 2015 (HGB-206); Data reported from an ongoing trial with an open database

Engraftment and Safety Summary

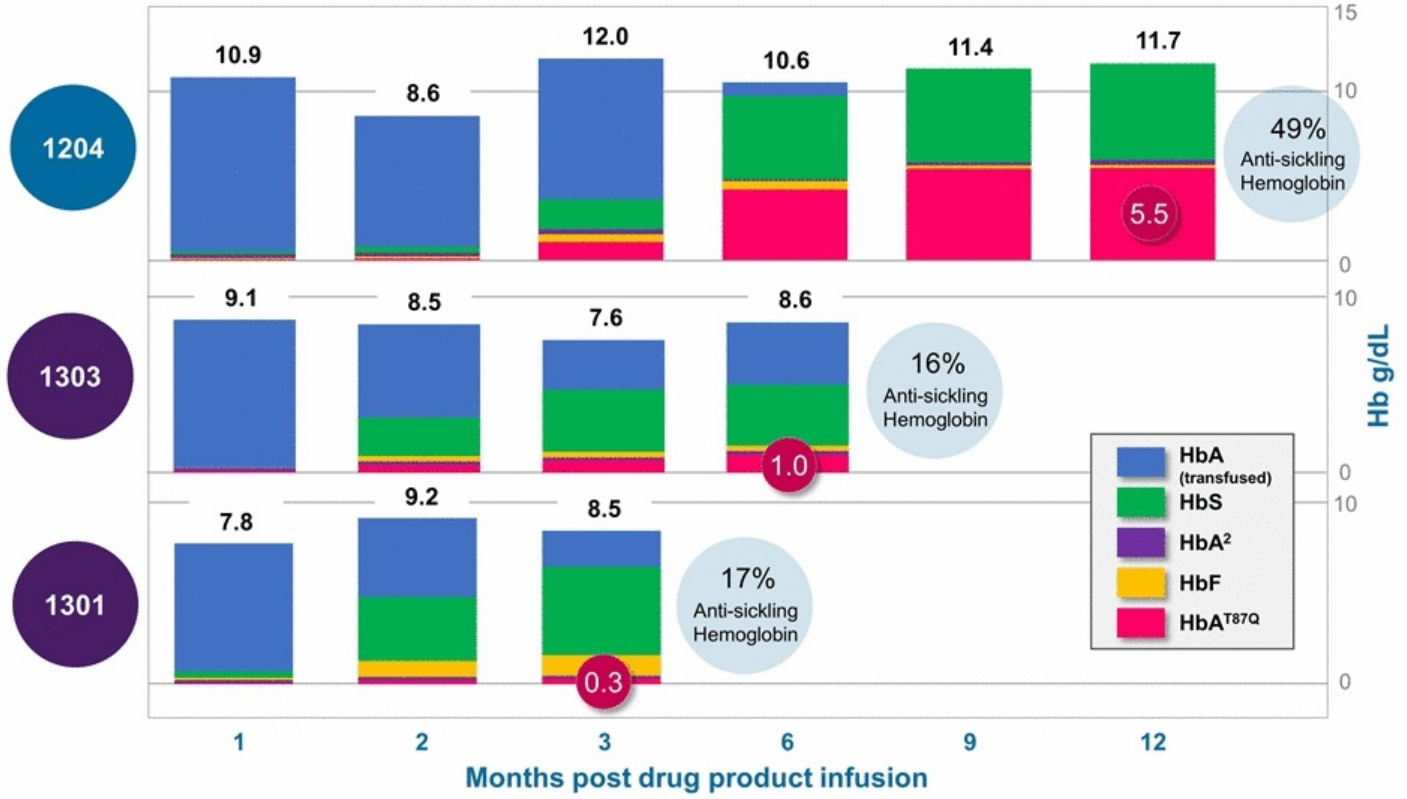
	HGB-205	HGB-206		
	1204	1301	1303	1306
Time since BB305 infusion	13.0 m	3.0 m	5.3 m	<1 m
Neutrophil engraftment[1]	Day + 37	Day +18	Day +16	--[3]
Platelet engraftment[2]	Day + 91	Day +29	Day +23	--[3]
Non-laboratory post-infusion grade 3-4 AEs	None	Fever, bacteremia, mouth pain, mucositis	Mucositis, fatigue, febrile neutropenia, anorexia, dyspnea	n/a
Serious AEs	None	Bacteremia (grade 4), VOC x2 (grade 3)	None	n/a

- No replication competent lentivirus detected in any subject to date
- Integration site analysis shows highly polyclonal repopulation with no clonal dominance detected at any time point
- No AEs assessed to be related to BB305 drug product

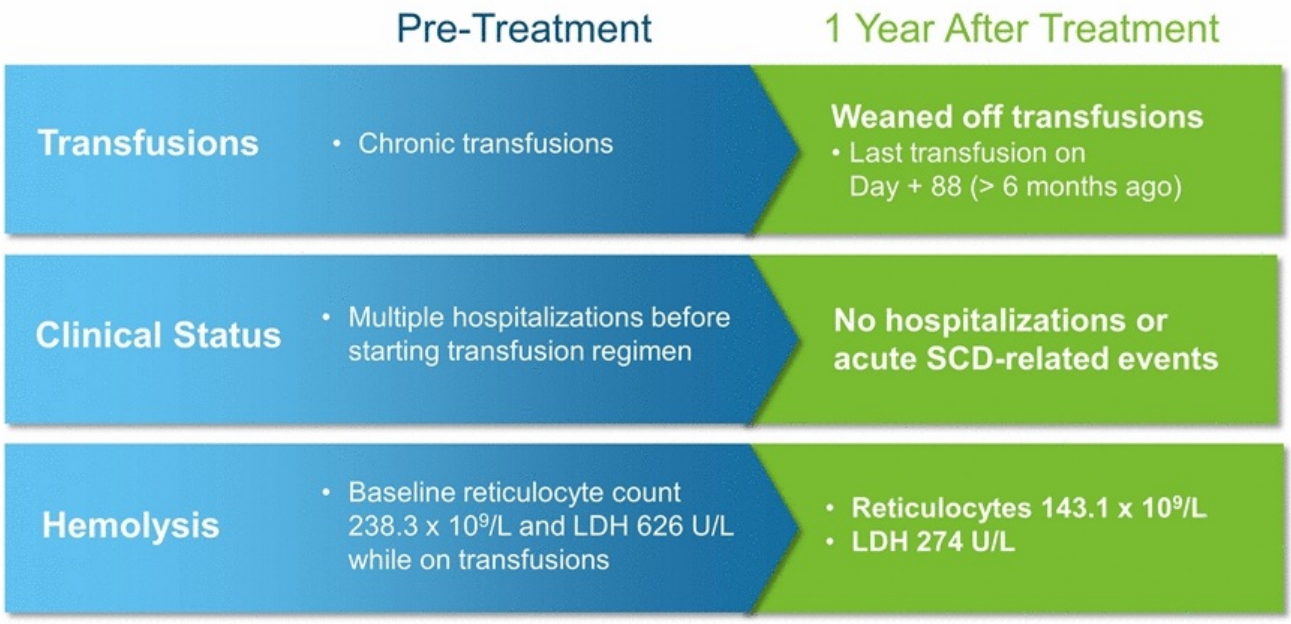
Data as of 01 Oct 2015.

*1.*ANC ≥ 500 for 3 consecutive days; 2. Unsupported platelet count ≥ 50,000/µL. 3. Engraftment not reported as of data cut-off. VOC: vaso-occlusive crisis

HbA^{T87Q} Production and Globin Change after Infusion



Severe SCD: Subject 1204 Free of Transfusions; No Hospitalizations



Transfusions discontinued and clinical status improved

Data as of November 10, 2015

Advancing LentiGlobin in β-thalassemia Major Building Evidence of Benefit in Severe SCD

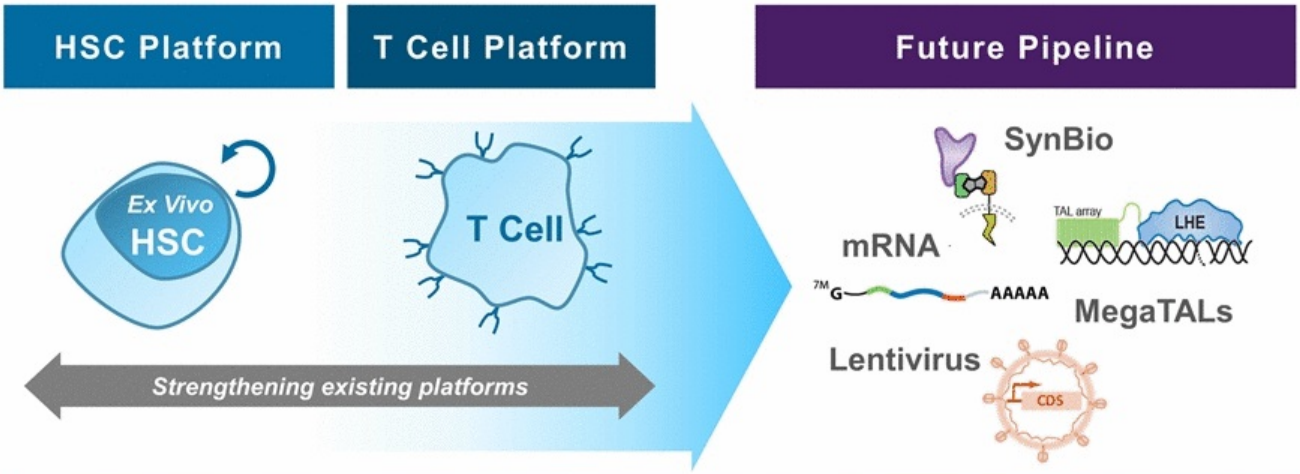
- Early transfusion independence data in patients with non-β0/β0 genotypes driving clinical and regulatory strategy
- Encouraging early transfusion reduction data in patients with β0/β0 genotype, but more data and longer follow-up needed
- Gaining further insight into additional variables with potential to affect outcomes in beta-thalassemia major and severe SCD:

Correlation between VCN and HbA^{T87Q} levels	Kinetics of HbA^{T87Q} production, and the impact on transfusion reduction/elimination	Impact of level of myeloablative conditioning

- Working to incorporate platform improvements to optimize patient outcomes

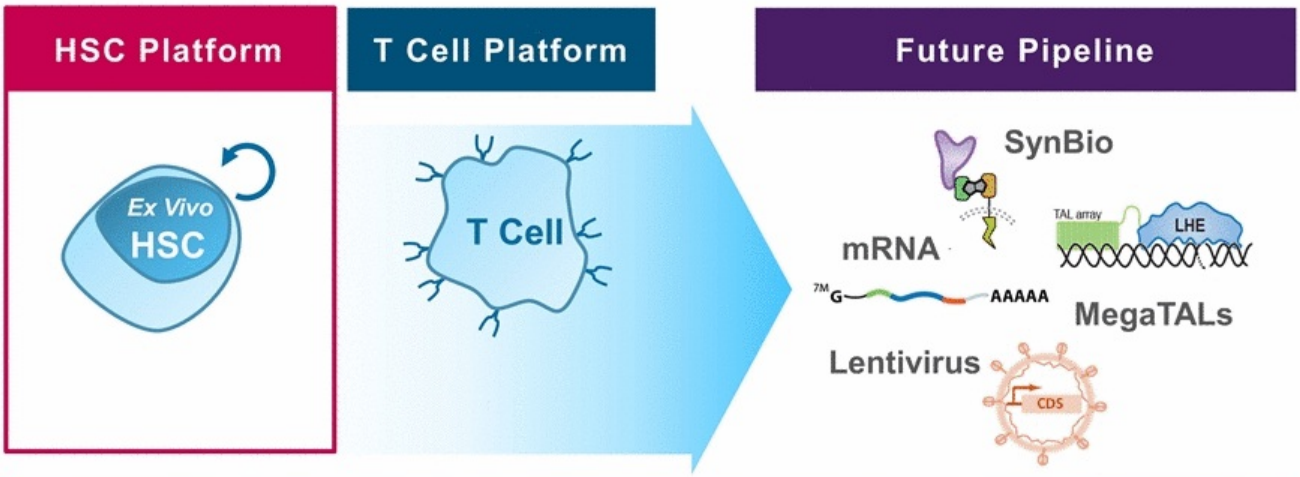

bluebirdbio®
Research Platform
Philip Gregory, D. Phil.
Chief Scientific Officer
Nasdaq : BLUE

Research Platform and Strategy



Drive toward sustainable IND engine with ability to feed pipeline for bluebird's future

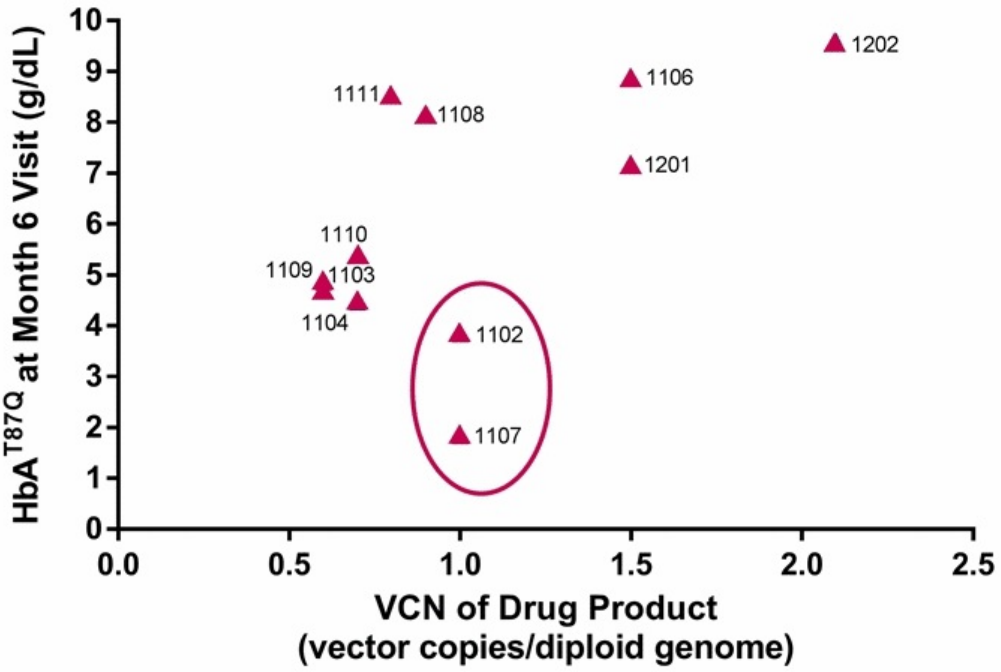
Research Platform and Strategy



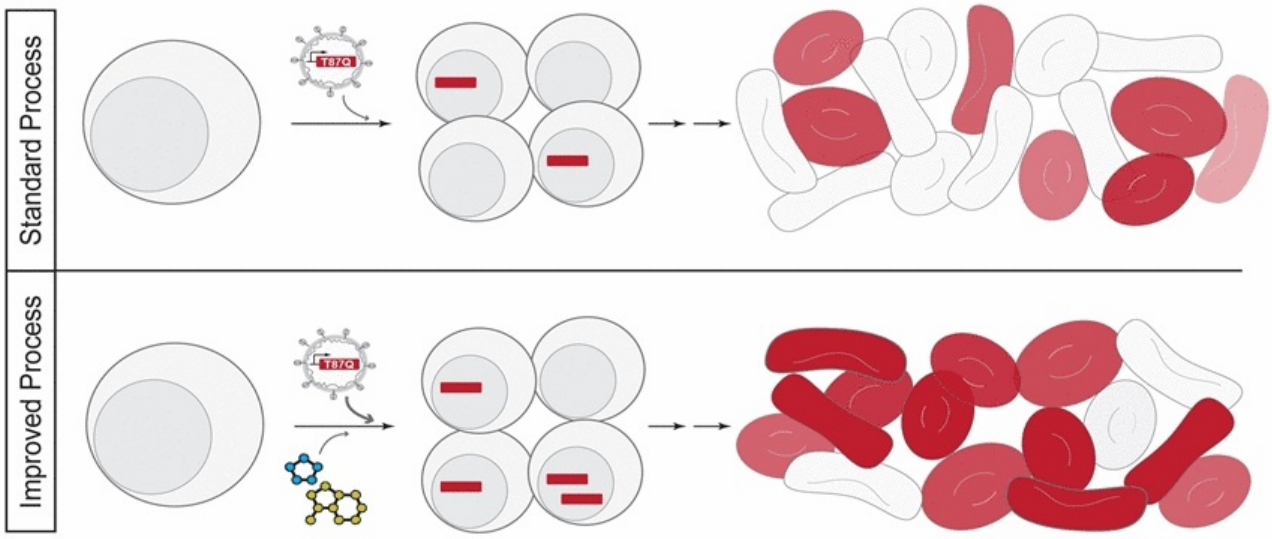
HSC Platform Research

- *Enhance therapeutic potential of bluebird's current clinical programs*
- *Leverage technology platform advantage to address additional indications*

Hypothesis: Improving VCN in the Drug Product Should Increase T87Q Levels and Further Improve Clinical Benefit

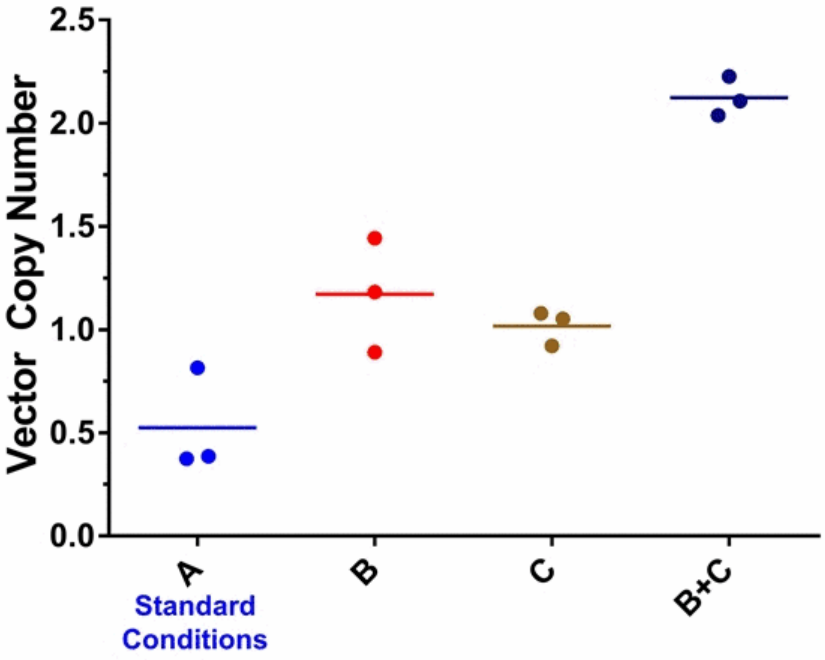


Improving VCN in the Drug Product
Identifying Compounds that Improve Transduction



Goal: *Increased VCN via increased transduction efficiency (% HSCs transduced)*

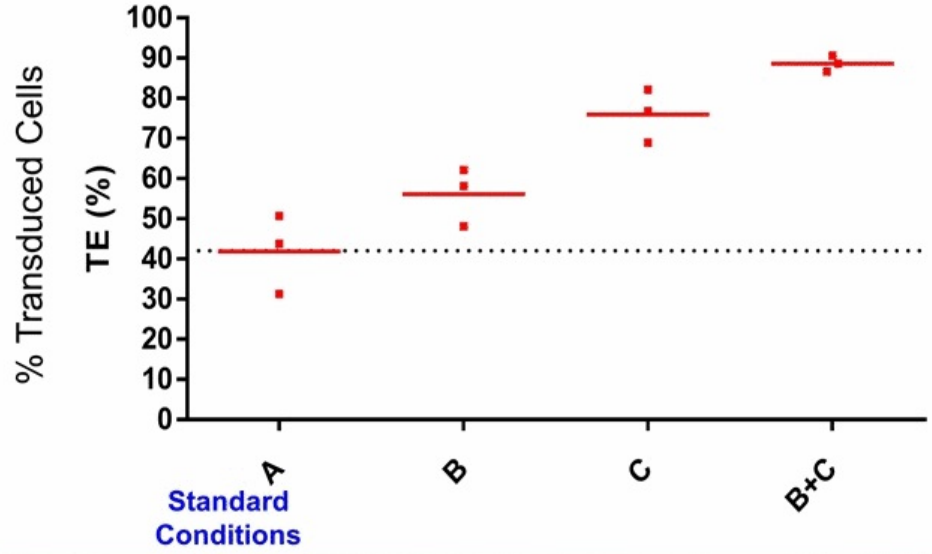
Improving VCN in the Drug Product
Selected Compounds from Screening Results



- Experiment performed with pre-characterized "*hard to transduce*" donor HSCs
- Similar fold improvement in VCN obtained across a wide range of donors, lentiviral vectors and LVV lots
- Process is well tolerated

*preliminary research findings

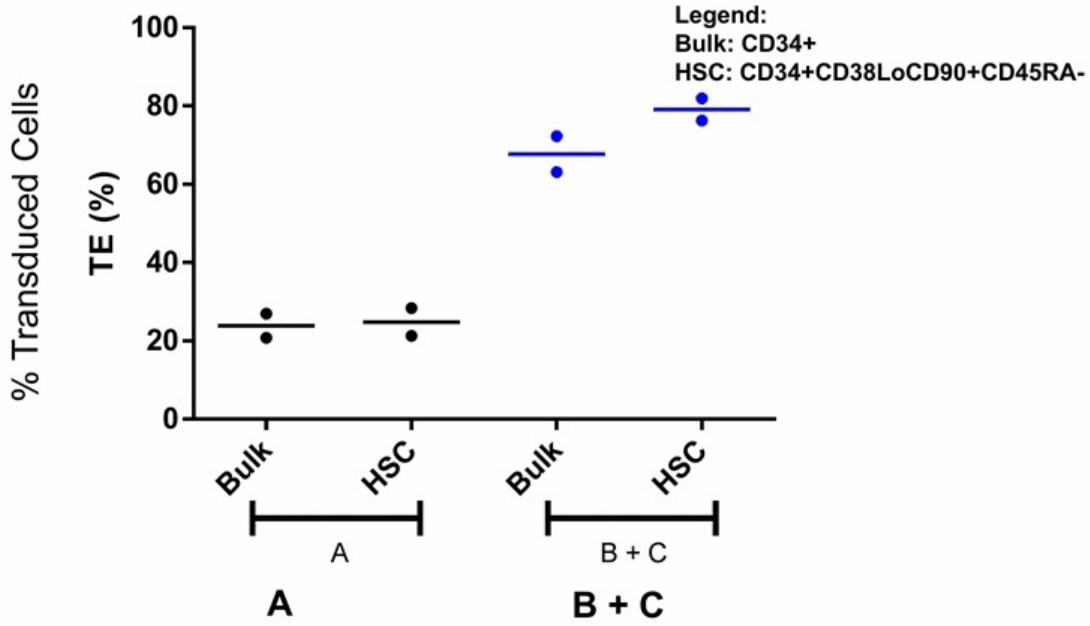
Improving VCN in the Drug Product
Markedly Increased % Corrected HSCs



Single-cell PCR assay demonstrates marked increase in transduction efficiency
Up to ~90% of the cells transduced using most optimized conditions

*preliminary research findings

Increased Transduction Efficiency Observed in the Most Primitive Long Term HSC Population



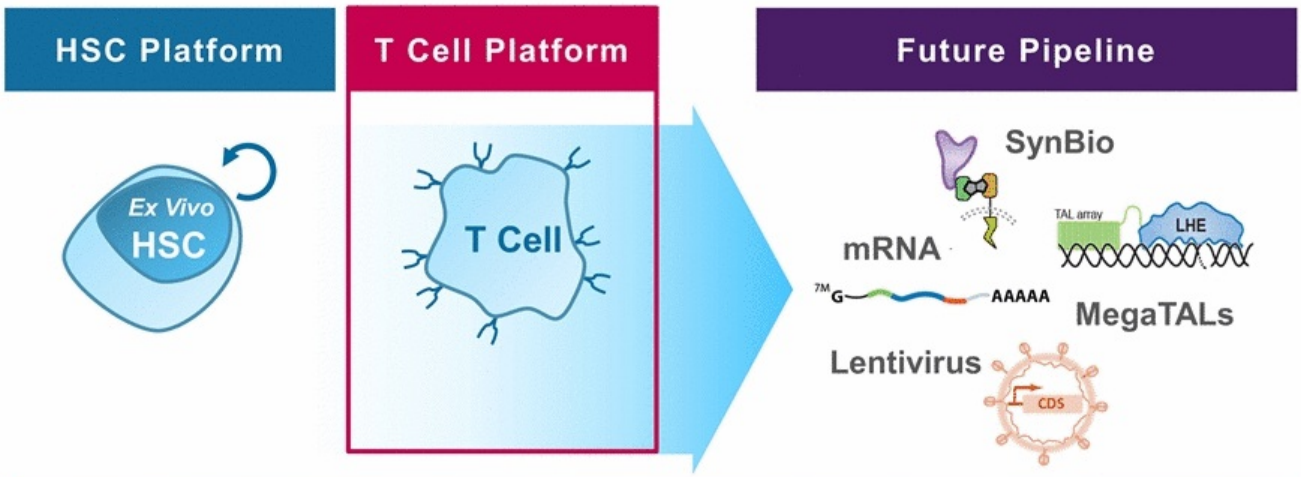
Goal of increased VCN via increased transduction efficiency (% transduced) achieved

*preliminary research findings

Improving VCN in the Drug Product
Key Takeaways

- Several different compounds identified that increase VCN in the drug product (both alone and in combination)
- Importantly, increased VCN is achieved in part by increasing the number of transduced cells (% HSCs carrying LentiGlobin)
- Long term HSCs show a similar magnitude of improvement in both VCN and % transduced cells
- Improving VCN in the drug product should increase T87Q levels and further improve clinical benefit

Research Platform and Strategy



T cell Platform Research

- *Intensely competitive space but with potential for transformative benefit*
- *Opportunity to exploit breadth of bbb technology platforms to potentially create "best in class" differentiated products*

Example 1: T Cell Lineages for Improved Anti-Tumor Activity

ASH | 57th Annual Meeting & Exposition
Orlando, FL • December 5-8, 2015

Manufacturing of an Enhanced CAR T Cell Product by Inhibiting PI3K / AKT Pathway During T Cell Expansion Results in Improved In Vivo Efficacy of Anti-BCMA CAR T Cells

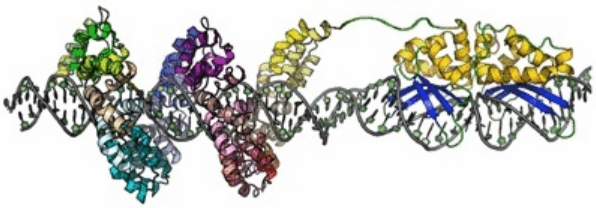
Adoptive Immunotherapy
Program: Oral and Poster Abstracts
Session: 703. Adoptive Immunotherapy: Poster I

Saturday, December 5, 2015, 5:30 PM-7:30 PM
Hall A, Level 2 (Orange County Convention Center)

Molly R. Perkins, D.Phil.[1], Shannon Grande, Ph.D.[1]*, Amanda Hamel, BS[2]*, Holly M. Horton, PhD[2], Tracy E. Garrett, BA[2]*, Sara M. Miller[1]*, Howard J. Latimer IV, BS2*, Christopher J. Horvath, DVM, MS, DACVP[2]*, Michael Kuczewski, MS[2]*, Kevin M. Friedman, PhD[2]* and Richard A. Morgan, PhD[2]*

[1]bluebird bio, Cambridge, MA
[2]bluebird bio, Inc, Cambridge, MA*

Example 2: bluebird Gene Editing Approach MegaTAL Technology



Expertise in homing endonucleases (HE) and MegaTALs

- Robust nuclease discovery platform, proprietary database, broad IP

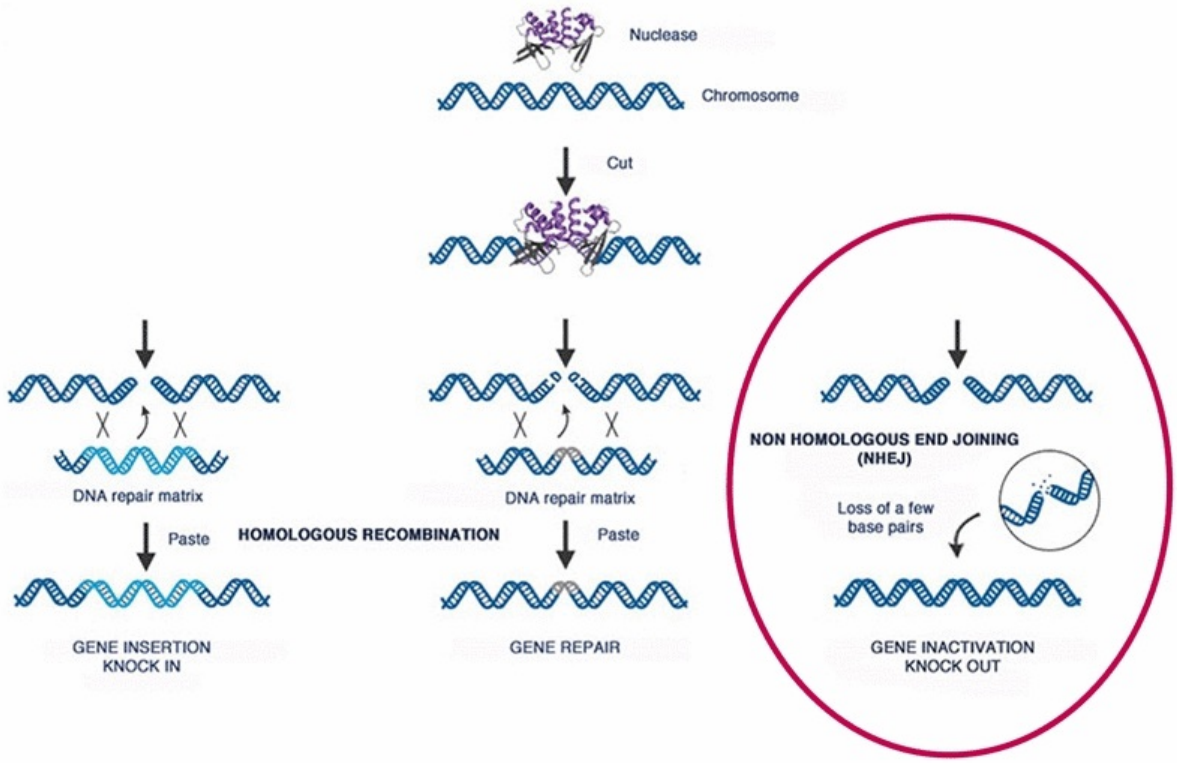
Multiple advantages of HE and MegaTALs

- Naturally occurring proteins
- Highly specific and efficient
- Compact size

Broad range of therapeutic applications

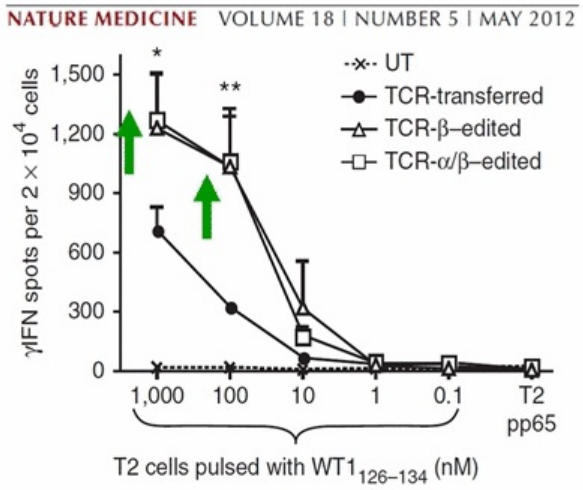
- Complementary to existing programs

MegaTAL Driven Genome Editing Outcomes

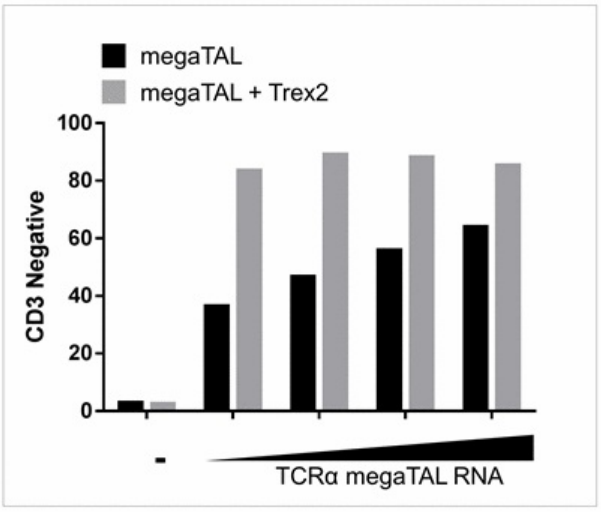


MegaTAL Platform Drives Efficient Gene Disruption
TCRα KO in T cells

TCRα editing generates more efficacious anti-tumor T cells

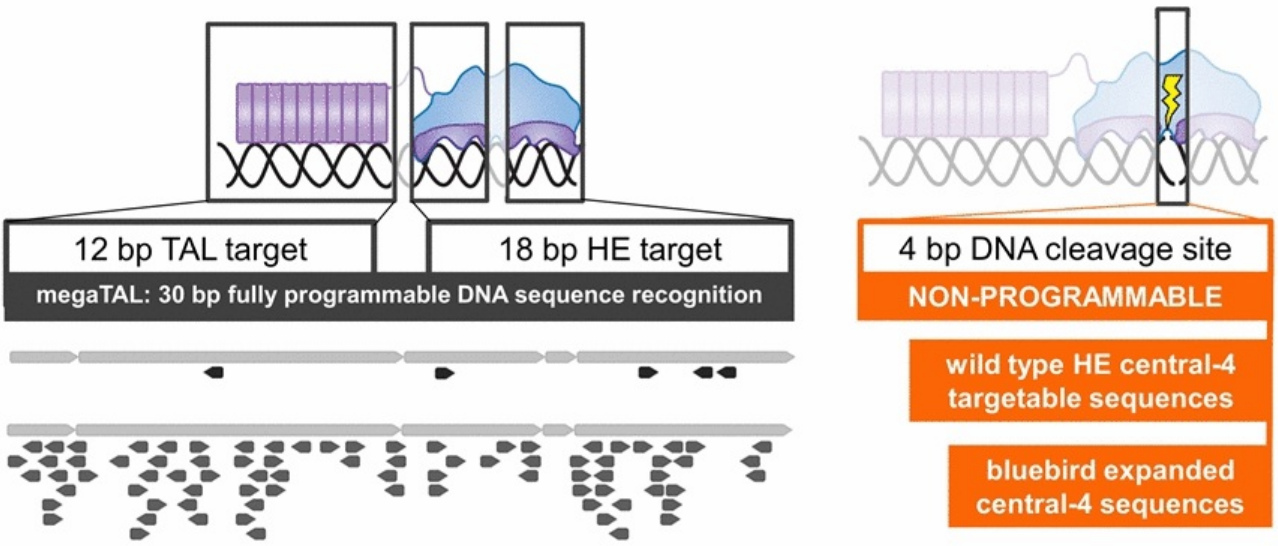


Efficient megaTAL TCRα gene KO



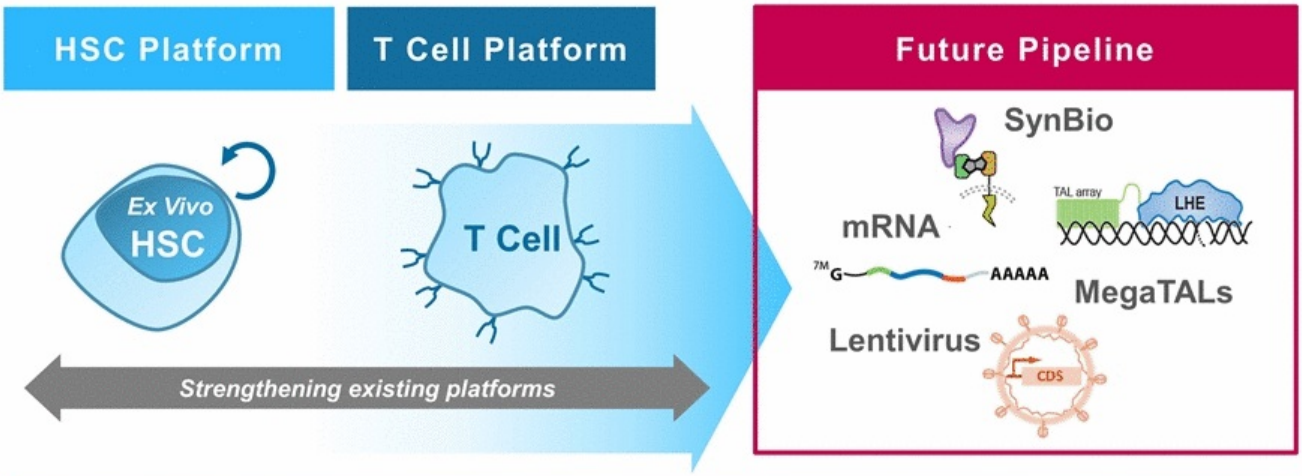
TCRα KO using bluebird megaTAL platform is fully compatible with current clinic scale process

Improving MegaTAL Design Density



Improved megaTAL platform enhances applicability across the universe of T cell targets and beyond

Research Platform and Strategy



Future Pipeline

- *Leverage academic collaborations to drive early innovative science*
- *Build on and extend technology platforms*
- *Establish a sustainable pipeline*

Leveraging Select Academic Collaborations
Operating at the Forefront of Innovation

Baylor College of Medicine

Celgene, bluebird bio, and the Center for Cell and Gene Therapy Combine Strengths and Resources to Develop T-cell Based Therapies for Cancer

On March 19, 2013, BCM signed an exclusive multiyear research and collaboration agreement and a platform technology license agreement with Celgene Corporation that launches the commercial development of novel immunotherapies involving manipulated T-cells that express chimeric antigen receptors (CAR CTLs)…

Seattle Children's
HOSPITAL · RESEARCH · FOUNDATION

Seattle Children's Research Institute Teams Up With bluebird bio to Pioneer Genome Editing and Gene Therapy Research in Pediatric Diseases

9.10.15

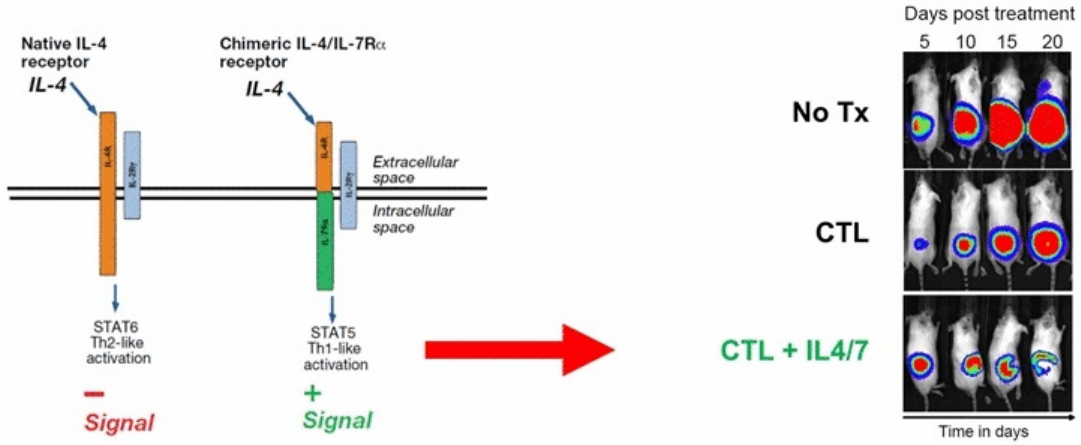
Gene therapy research aims to cure pediatric diseases early in life by targeting and repairing the disease-causing genes in a patient's own genome…

Boolean Immunotherapy
Turning a Negative T cell Signal into a Positive One

Reversal of Tumor Immune Inhibition Using a Chimeric Cytokine Receptor

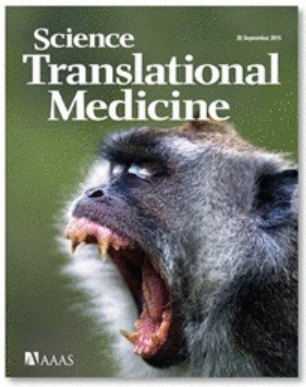
Ann M Leen[1], Sujita Sukumaran[1], Norihiro Watanabe[1], Somala Mohammed[1], Jacqueline Keirnan[1], Ryu Yanagisawa[1], Usanarat Anurathapan[1], David Rendon[2], Helen E Heslop[1], Cliona M Rooney[1], Malcolm K Brenner[1] and Juan F Vera[1]

[1]Center for Cell and Gene Therapy, Baylor College of Medicine, Texas Children's Hospital and Houston Methodist Hospital, Houston, Texas, USA; [2]Baylor College of Medicine, Texas Children's Hospital and Houston Methodist Hospital, Houston, Texas, USA



MegaTAL Enabled Targeted Gene Addition

Precision Offers Promise of Enhanced Efficacy and Safety



RESEARCH ARTICLE

GENOME EDITING

Efficient modification of *CCR5* in primary human hematopoietic cells using a megaTAL nuclease and AAV donor template

Blythe D. Sather,[1]* Guillermo S. Romano Ibarra,[1]* Karen Sommer,[1] Gabrielle Curinga,[1] Malika Hale,[1] Iram F. Khan,[1] Swati Singh,[1] Yumei Song,[1] Kamila Gwiazda,[1] Jaya Sahni,[1] Jordan Jarjour,[2] Alexander Astrakhan,[2] Thor A. Wagner,[3,4] Andrew M. Scharenberg,[1,4,5†] David J. Rawlings[1,4,5†]

Seattle Children's
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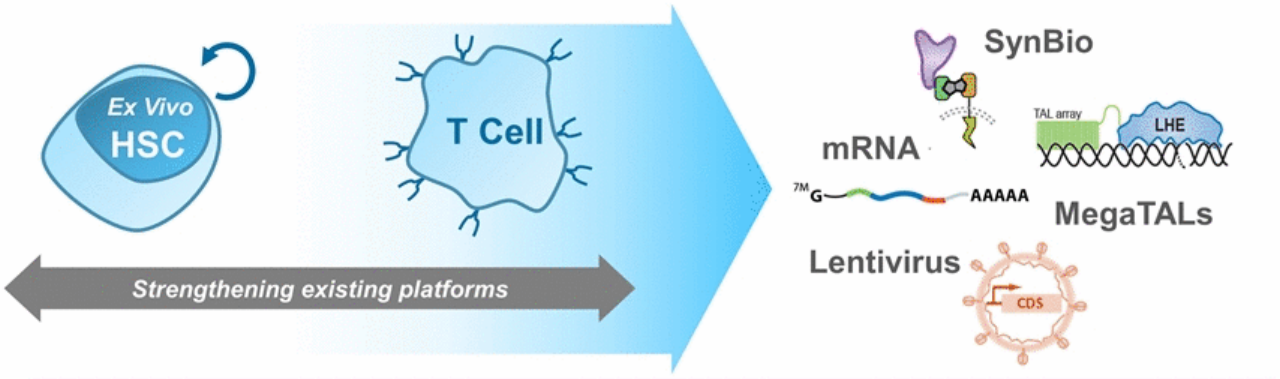
Demonstrates power of megaTAL and AAV platforms – supports NextGen HSC and Cancer Immunotherapy Programs

Research Platform and Strategy
Key Takeaways

HSC Platform | **T Cell Platform** | **Future Pipeline**

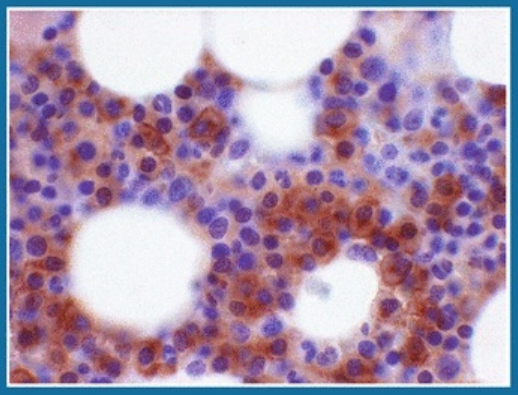


- Powerful research platform with multiple tools and technologies
- Today highlighted selected efforts to:
  - Enhance the therapeutic potential of current clinical programs
  - Apply combinations of bluebird's tools / technologies to potentially create "best in class" therapeutic products
  - Drive early innovative science via select academic collaborations
- Goal is to build a product candidate engine to file INDs and feed future pipeline


bluebirdbio®
Immuno-Oncology
Richard Morgan, Ph.D.
Vice President, Immunotherapy
Rob Ross, M.D.
Head of Oncology
Nasdaq : BLUE

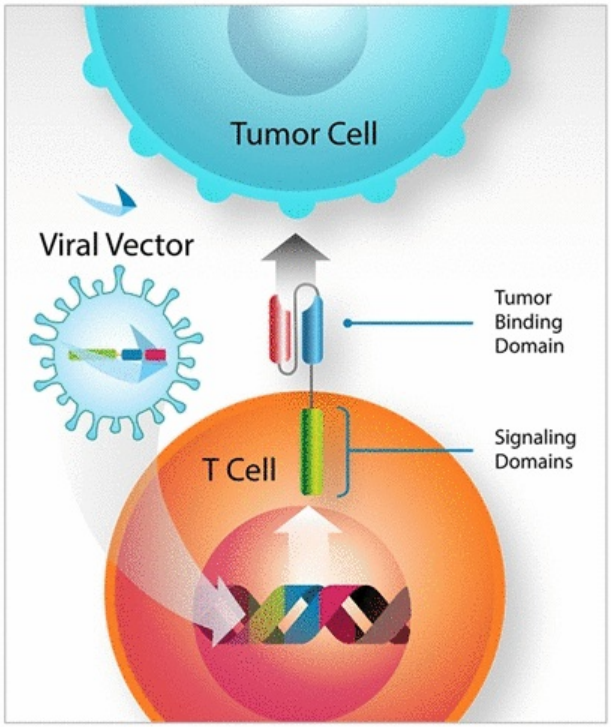
BCMA: A Promising Target in Multiple Myeloma

- B cell maturation antigen (BCMA) is a member of the TNF receptor superfamily.
- BCMA binds B cell activating factor (BAFF) and a proliferation-inducing ligand (APRIL). BCMA is expressed by plasma cells and some mature B cells.
- Mice deficient in BCMA are healthy and have normal numbers of B cells, but reduced survival of plasma cells.
- BCMA RNA is near universally detected in multiple myeloma (MM) cells, and BCMA protein is detected on the surface of malignant plasma cells from patients with MM.



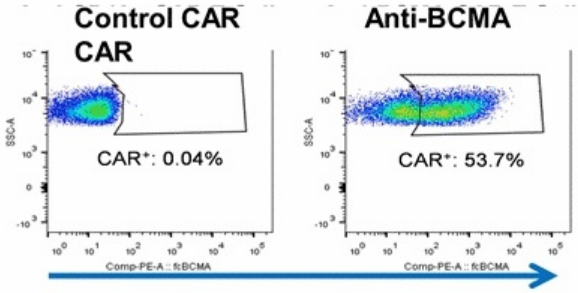
Multiple myeloma cells expressing BCMA
(brown color is BCMA protein)

Anti-BCMA CAR – bb2121



bb2121 Vector Design

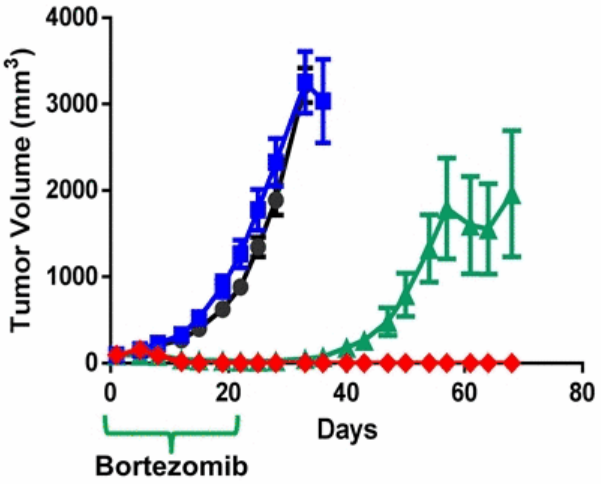
bb2121 CAR Expression



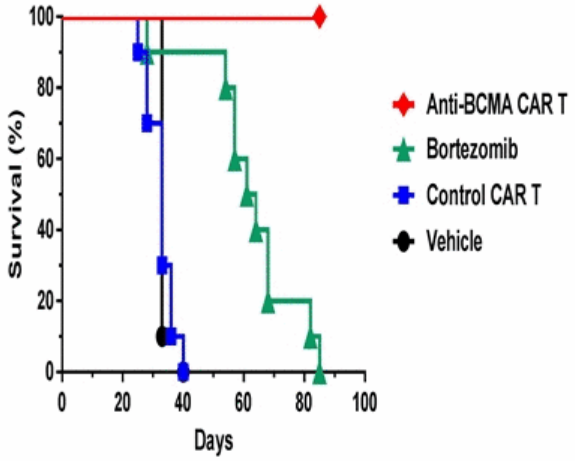
Anti-BCMA CAR Expression

A Single Treatment with bb2121 CAR T Cells Clears Animals of MM and Results in 100% Survival

Tumor treatment

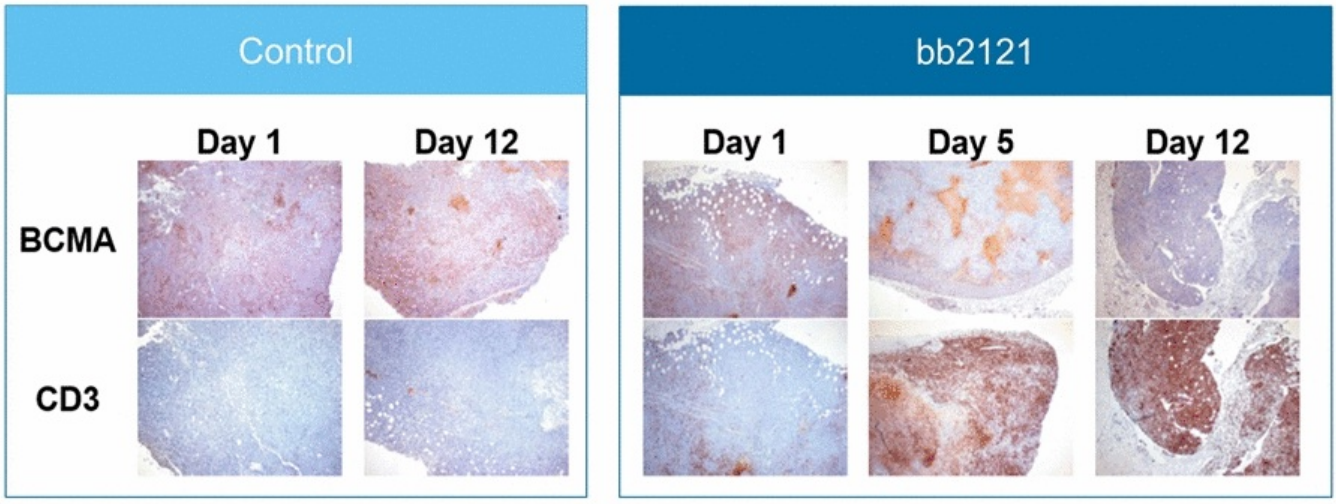


Survival



Anti-BCMA CAR T Bortezomib Control CAR T Vehicle

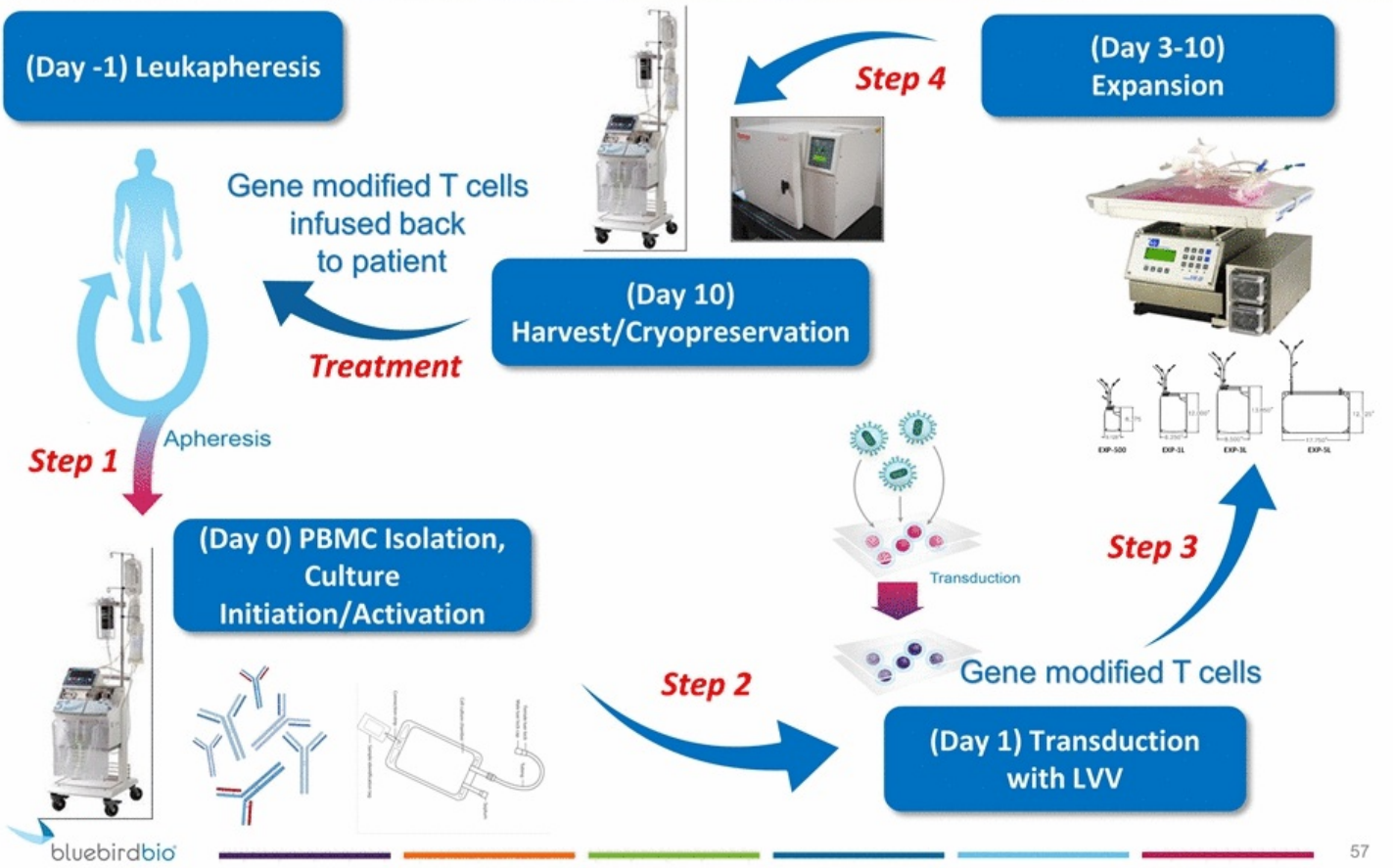
bb2121 CAR T Cells Infiltrate and Eliminate BCMA+ MM Tumors



Brown staining indicates presence of target protein

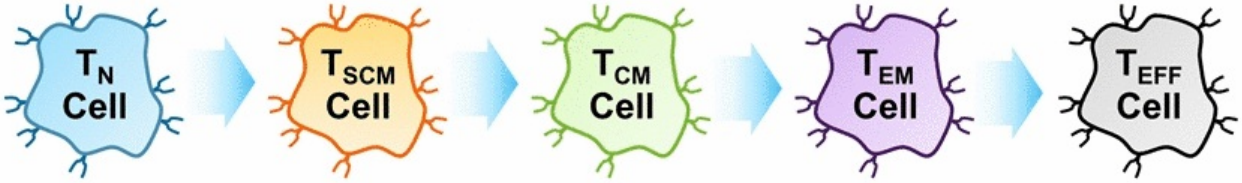
- In control mice, the BCMA+ MM tumor expands, and no CD3+ cells infiltrate
- In bb2121 treated mice, the BCMA+ MM tumor regresses; CD3+ CAR T cells infiltrate and eliminate the tumor

An Efficient CAR T Drug Product Manufacturing Process



Manipulating T Cell Lineages for Improved Anti-Tumor Activity

T Cell Lineages Post-Antigen Stimulation

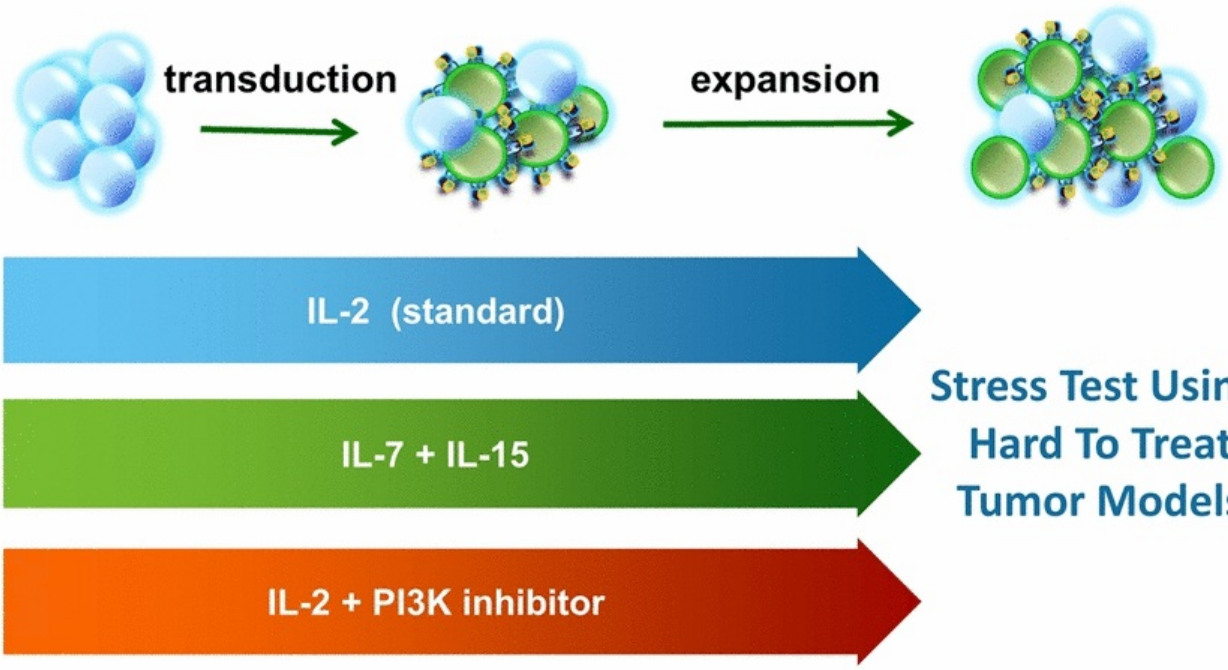


T Cell Plasticity
Self Renewal
Long Lived

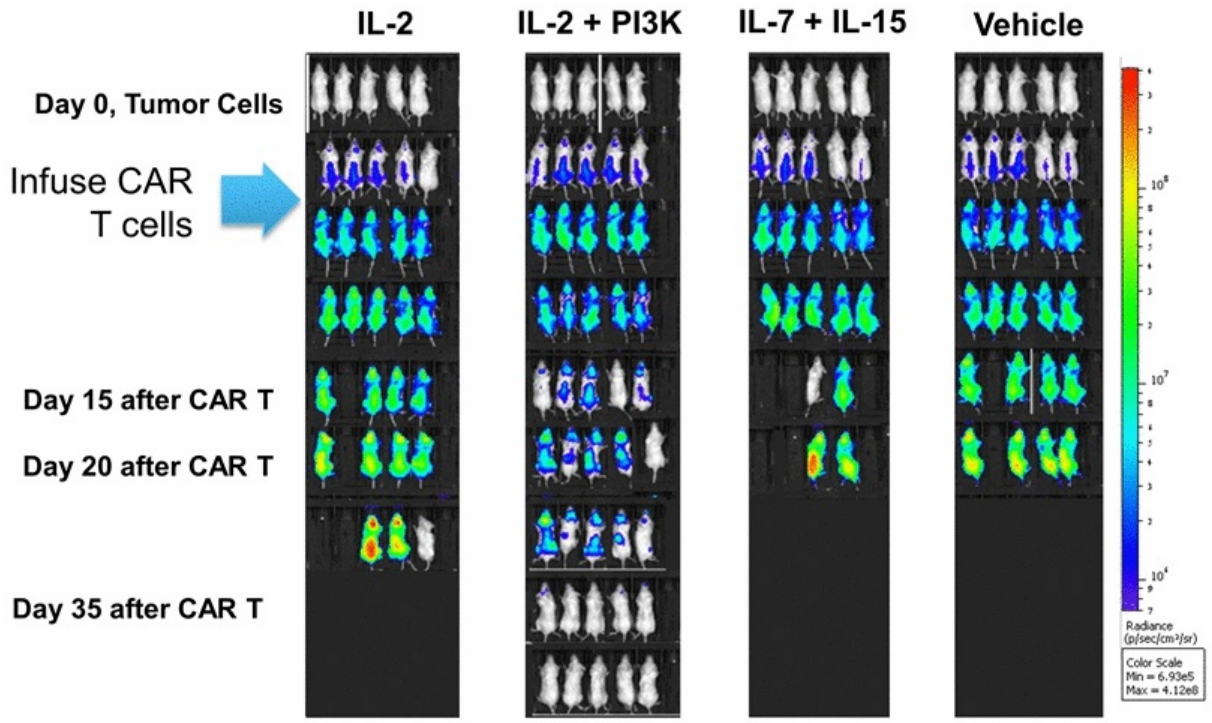
Terminally Differentiated
No Self Renewal
Short Lived

Goal: Generate More Efficacious Anti-Tumor T Cells

Improved T Cell Manufacturing



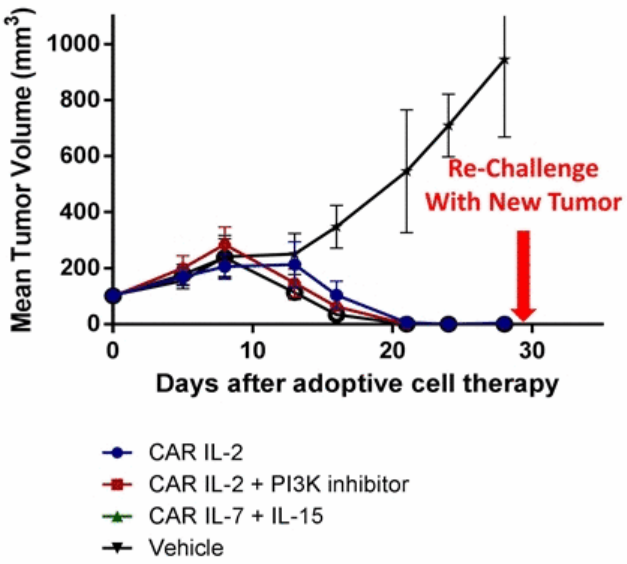
Stress Test 1: Treating an Aggressive Lymphoma with a Minimal Number of bb2121 T Cells

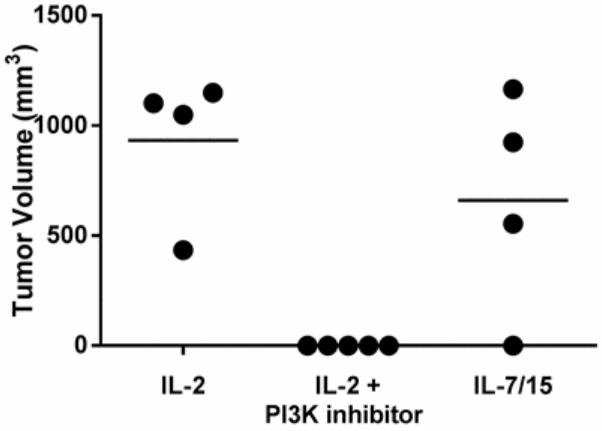


Stress Test 2: Use a Cancer Relapse Model as a Measure of bb2121 T Cell Durability and Long-Term Fitness

Primary Tumor Treatment

Tumor Re-Challenge





Deepening Pipeline

Product Candidates	Program Area	Preclinical	Phase 1/2	Phase 2/3	Rights/Partner
	CNS Diseases				
Lenti-D™	Childhood Cerebral ALD				Worldwide
	Rare Hemoglobinopathies				
LentiGlobin®	Beta-thalassemia Major*				Worldwide
	Severe Sickle Cell Disease				Worldwide
	Oncology				
bb2121 BCMA	Multiple Myeloma				Celgene
Next Gen BCMA	Multiple Myeloma				Celgene
Five Prime Target	Undisclosed				Worldwide
HPV-16 E6 TCR	HPV-associated Cancers				Kite Pharma
Viromed Target	Undisclosed				Worldwide excluding Korea
Other Programs	Undisclosed				Worldwide
	Research				
Early Pipeline	Undisclosed + Gene Editing				Worldwide

* The current clinical trials for LentiGlobin are Phase 1/2 studies that may provide the basis for early conditional approval in some jurisdictions

Promising Proof of Concept for bb2121 from NCI Latebreaker with Other Anti-BCMA CAR T Therapy

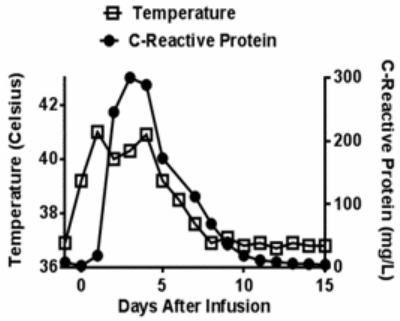
Summary of all patient's CAR-BCMA cells doses and responses

Patient	Myeloma type	CAR-BCMA cell dose (T cells/kg)	Response (duration in weeks)
1	κ light chain only	$0.3x10^6$	PR (2)
2	IgA λ	$0.3x10^6$	SD (6)
3	κ light chain only	$0.3x10^6$	SD (6)
4	λ light chain only	$1x10^6$	SD (10)
5	IgG κ	$1x10^6$	SD (4)
6	IgG λ	$1x10^6$	SD (2)
7	IgG λ	$3x10^6$	SD (6)
8	κ light chain only	$3x10^6$	VGPR (8)
9	κ light chain only	$3x10^6$	SD (10+)
10	IgA κ	$9x10^6$	Stringent CR (6+)
11	IgG λ	$9x10^6$	PR (6+)
12	IgA λ	$3x10^6$	SD (2)

Data from NCI-sponsored Phase 1 first-in-human study of anti-BCMA CAR T therapy in heavily pre-treated patients with multiple myeloma as presented at ASH 2015 press conference
Presenter and PI Jim Kochenderfer, M.D., will serve as a PI for bluebird Phase 1 study of bb2121

Promising Proof of Concept for bb2121 from NCI Latebreaker with Other Anti-BCMA CAR T Therapy

Patient 10 experienced significant toxicity after CAR-BCMA T-cell infusion



- Patient 10 experienced cytokine release syndrome including fever, tachycardia, hypotension, elevated liver enzymes, and elevated creatinine kinase-all resolved in 2 weeks or less
- The patients absolute neutrophil count was less than 500/μL at the time of CAR T-cell infusion and remained less than 500/μL for 40 days after infusion
- The patient was platelet transfusion-dependent for 9 weeks after infusion

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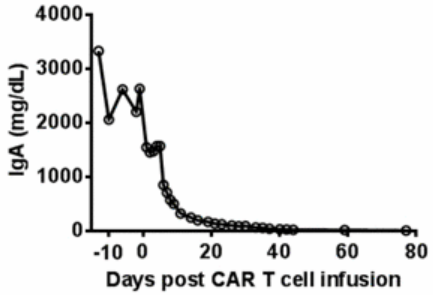
Promising Proof of Concept for bb2121 from NCI Latebreaker with Other Anti-BCMA CAR T Therapy

Patient 10 obtained an ongoing stringent complete remission of chemotherapy-resistant IgA myeloma after CAR-BCMA T-cell infusion



- **Serum and urine immunofixation-negative**
- **Bone marrow flow cytometry-negative**

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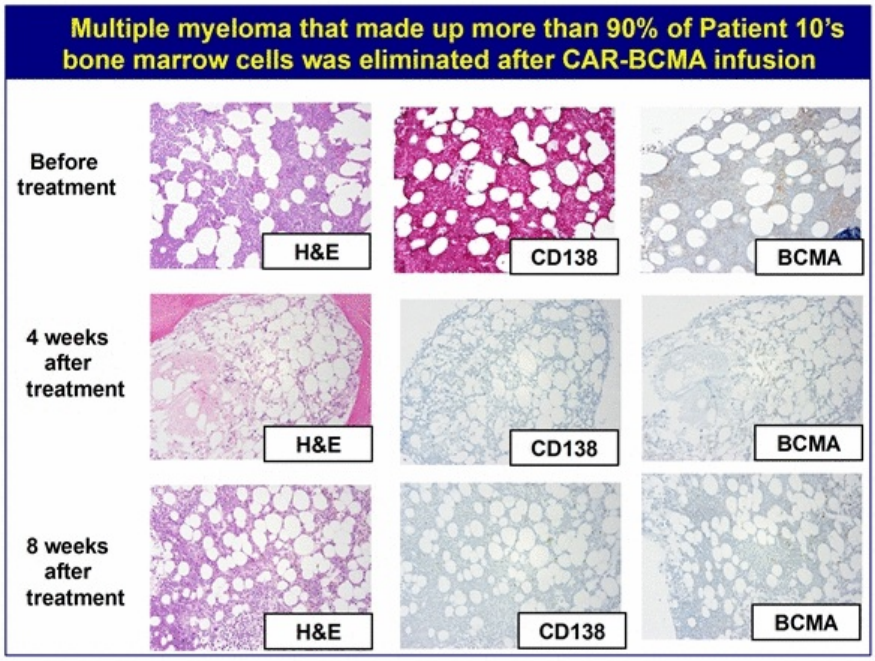

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bluebird bio's First Oncology Clinical Trial

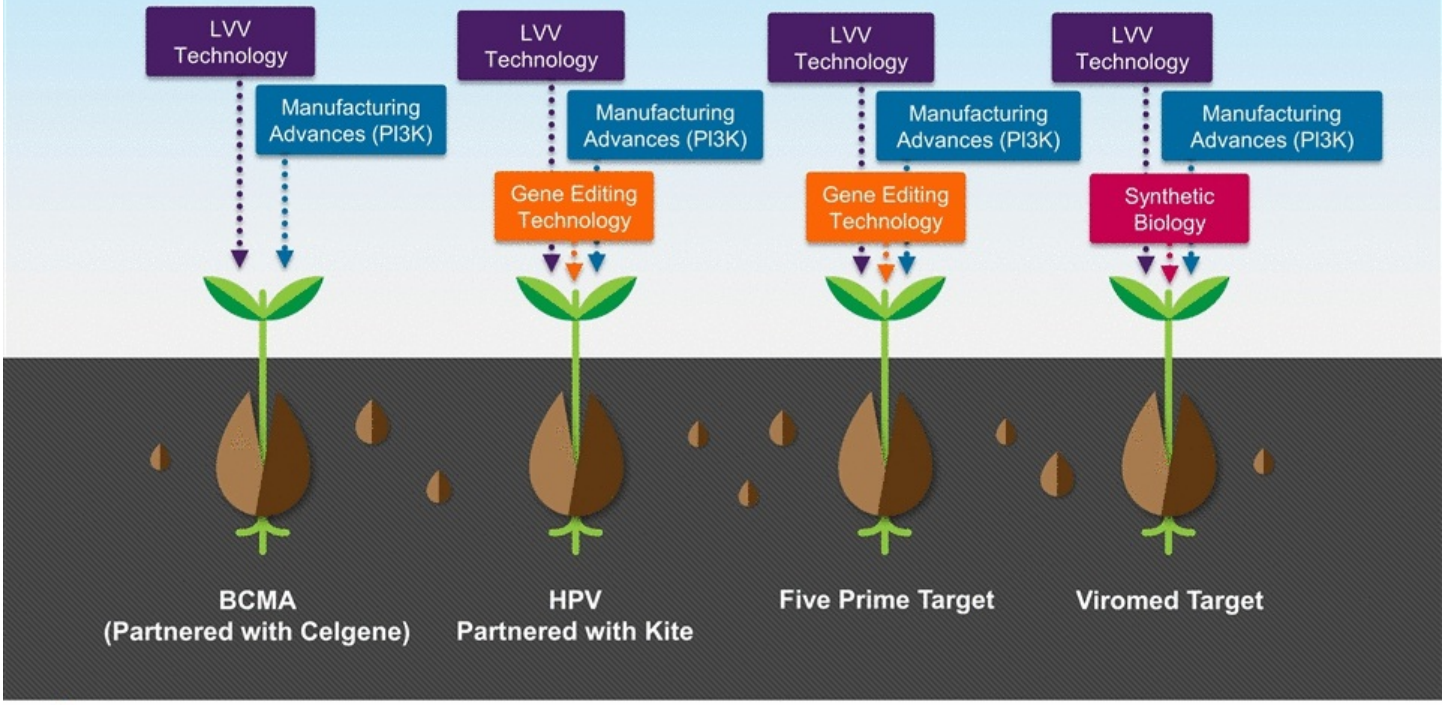
CRB-401
(Refractory Multiple Myeloma)

U.S.-based, 6-10 clinical sites – including NCI

- N = 40 patients, standard 3+3 Design based on CAR+ T cells doses
- Primary endpoint = Determine the maximally tolerated dose and recommended phase 2 dose (RP2D)
- Subjects must have received 3 prior regimens including a proteasome inhibitor (bortezomib, carfilzomib) and immunomodulatory agent (lenalidomide, pomalidomide)
- Following screening, enrolled subjects will undergo a leukapheresis procedure to collect autologous mononuclear cells for manufacturing of bb2121.
- Following manufacture of the drug product, subjects will receive one cycle of lymphodepletion prior to bb2121 infusion

Differentiated Oncology Approach

Deliver differentiated, best-in-class, genetically modified cellular products to patients suffering from cancer.



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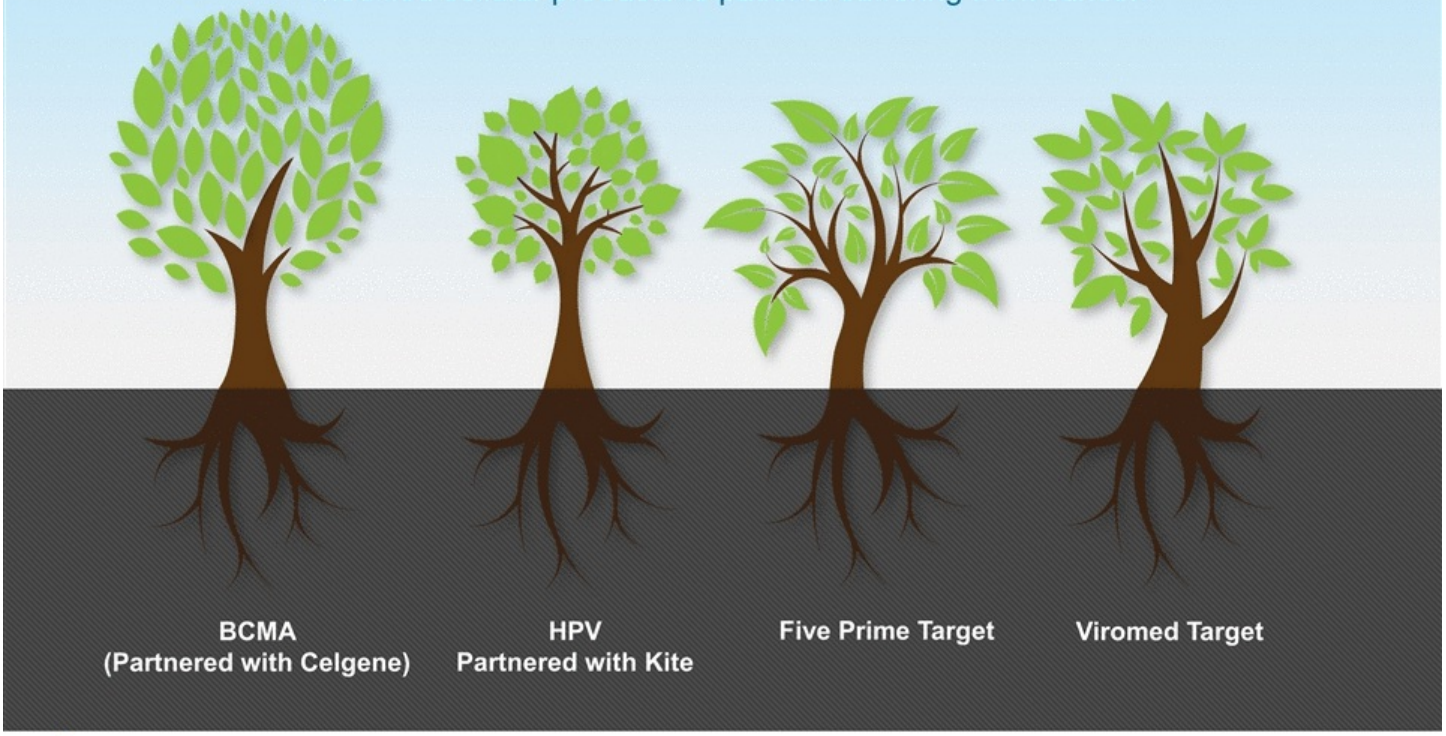
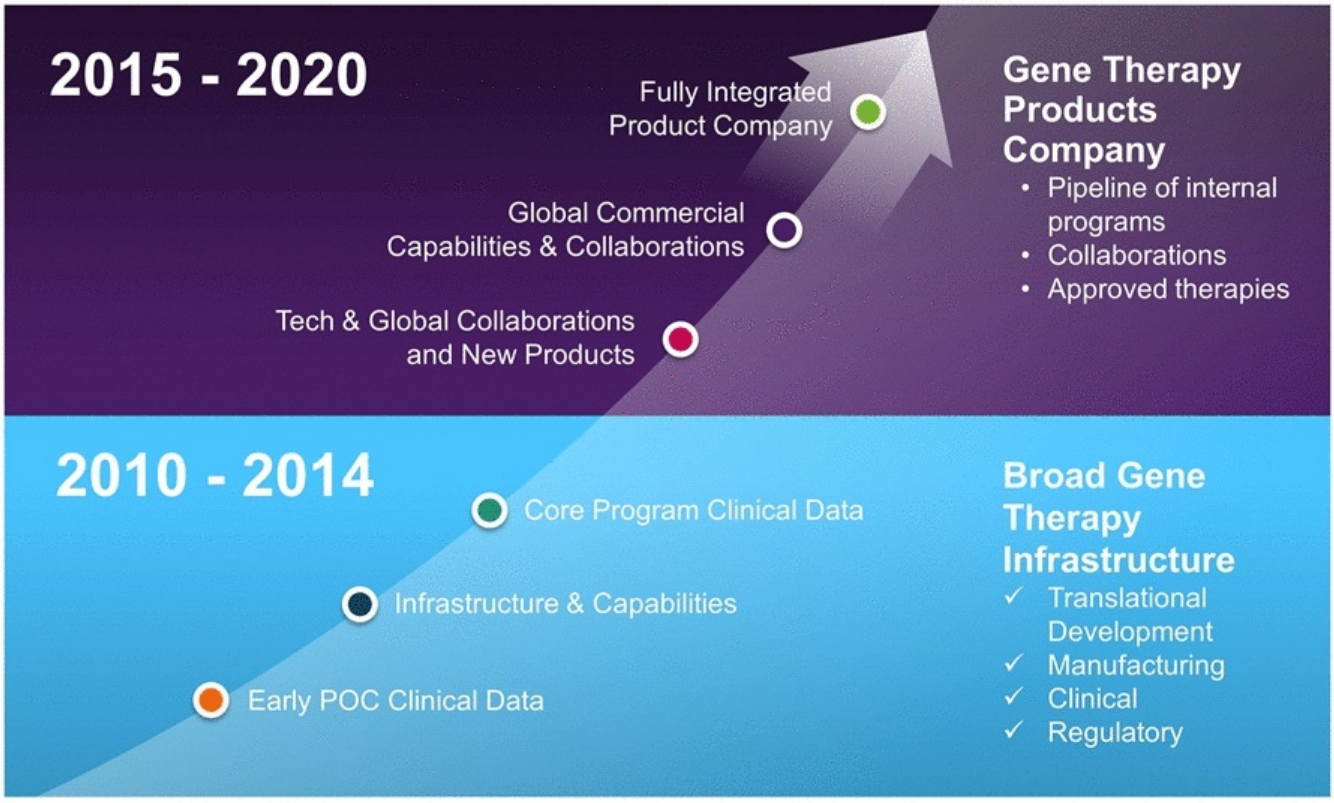



bluebirdbio®
Closing
Nick Leschly
Chief Bluebird
Nasdaq : BLUE

Asking the Important Questions

- What is the β-thalassemia clinical/regulatory path forward?
- What is the SCD data telling us?
- What are you doing to improve your platform?
- What are you doing to build a sustainable pipeline?
- What is the plan for oncology/BCMA?

bluebird bio 2020: The Gene Therapy Products Company



Q&A