Final Phase 3 Study Data Show SPINRAZA® (nusinersen) Significantly Improved Motor Function in Children with Later-Onset Spinal Muscular Atrophy

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Presymptomatic Infants Continued to Achieve Motor Milestones Generally Consistent with Normal Development in New Interim Data Analysis

Positive Data Across a Broad Range of Individuals with SMA Presented at the American Academy of Neurology Annual Meeting

CAMBRIDGE, Mass.--(BUSINESS WIRE)--Biogen (NASDAQ:BIIB) will present Phase 3 end of study SPINRAZA® (nusinersen) data from CHERISH, which demonstrated a highly statistically significant and clinically meaningful improvement in motor function in children with later-onset (most likely to develop Type 2 or Type 3) spinal muscular atrophy (SMA) compared to untreated children. The overall findings continue to support the robust efficacy and favorable safety profile of SPINRAZA across a broad range of individuals with SMA. The SPINRAZA development program represents the largest body of clinical data of its kind in SMA. SPINRAZA data will be presented at the American Academy of Neurology (AAN) annual meeting in Boston, Mass., April 22-28, 2017.

“The CHERISH study, conducted in collaboration with Ionis, further demonstrates the meaningful impact SPINRAZA can have in children with later-onset SMA, and reaffirms the benefit of treatment across SMA populations,” said Alfred Sandrock, M.D., Ph.D., executive vice president and chief medical officer at Biogen. “Our clinical development program demonstrates the impact of early treatment, which is confirmed by NURTURE data showing significant motor milestone improvements generally consistent with normal development in presymptomatic infants treated with SPINRAZA.”

CHERISH: Later-onset SMA (Most Likely to Develop Type 2 or Type 3)

CHERISH is a Phase 3, multicenter, randomized, double-blind, sham-procedure controlled study to assess the efficacy and safety of SPINRAZA in children with later-onset SMA. The 15-month study investigated SPINRAZA in 126 non-ambulatory children 2 to 12 years old who experienced symptom onset at greater than 6 months of age.

In the CHERISH end of study analysis, children on SPINRAZA demonstrated a highly statistically significant and clinically meaningful improvement in motor function, as observed by the treatment difference of 4.9 points in the mean change from baseline to Month 15 in the Hammersmith Functional Motor Scale Expanded (HFMSE) score (p=0.0000001). The HFMSE is a validated tool specifically designed to assess motor function in children with SMA. When measuring changes from baseline, children who received SPINRAZA (n=84) achieved a 3.9 point mean improvement at Month 15, while children who were not on treatment (n=42) experienced a mean decline of 1.0 point. Primary endpoint results of the end of study analysis were consistent with results observed at the interim analysis.

Data from the other endpoints analyzed, including attainment of new motor milestones and upper limb motor function, were consistently in favor of children who received treatment.

SPINRAZA demonstrated a favorable safety profile. Treatment-emergent adverse events (AEs), severe AEs and serious AEs (SAEs) were reported less frequently in children treated with SPINRAZA than those not on treatment. The majority of the AEs were considered to be either related to SMA disease, common events in the general population, or events related to the lumbar puncture procedure. No children discontinued the study due to AEs.

“In CHERISH, most children with later-onset SMA treated with SPINRAZA saw improvements in motor function and stabilization or slowing of disease progression,” said Dr. Richard Finkel, chief of neurology, Nemours Children's Hospital, Orlando, Florida. “As a physician who has spent 37 years treating children with SMA, it’s incredibly encouraging to see some patients on SPINRAZA achieve milestones such as crawling and standing with assistance within the clinical trial. These kinds of clinically meaningful improvements are unprecedented and give new hope to individuals with SMA and their families.”

NURTURE: Presymptomatic Infants with SMA

Biogen will also present new interim data from the Phase 2, multicenter, open-label, single-arm NURTURE study evaluating SPINRAZA for the treatment of infants under six weeks old with genetically diagnosed SMA who were presymptomatic at treatment initiation. At the time of the interim analysis, infants (n=20) were enrolled for a median of 317.5 days, and all infants were alive and none required respiratory intervention (chronic non-invasive ventilation, invasive ventilation or tracheostomy). Further, most infants achieved motor milestone and growth parameter gains generally consistent with normal development, such as head control, independent sitting, standing and walking independently, as measured by validated scales.

Three infants experienced AEs considered possibly related to SPINRAZA by the investigator, all of which were resolved. No infants have discontinued or withdrawn from the study due to AEs, and no new safety concerns have been identified.

“The results from NURTURE are significant, as they continue to demonstrate the importance of beginning SPINRAZA treatment as soon as possible after an SMA diagnosis and the major impact that early treatment may have across a broad range of SMA populations,” said Sandrock.

For more information about SPINRAZA and U.S. prescribing information, visit www.SPINRAZA.com .

The CHERISH and NURTURE slide presentations will be available concurrently with the AAN sessions on the Investor section of the Biogen company website, www.Biogen.com.

SPINRAZA Program Status

Biogen licensed the global rights to develop, manufacture and commercialize SPINRAZA from Ionis Pharmaceuticals (NASDAQ:IONS), a leader in antisense therapeutics. Biogen and Ionis conducted an innovative clinical development program that moved SPINRAZA from its first dose in humans

in 2011 to its first regulatory approval by the United States Food and Drug Administration (FDA) in 2016.[2]

SPINRAZA was first approved by the FDA on December 23, 2016 within three months of regulatory filing for the treatment of SMA in pediatric and adult patients. In April 2017, the Committee for Medicinal Products for Human Use (CHMP) of the European Medicines Agency (EMA) adopted a positive opinion recommending the granting of a marketing authorization for SPINRAZA for the treatment of 5q SMA, following review under an Accelerated Assessment program. A decision from the European Commission (EC) is expected in the next few months. Biogen has also submitted regulatory filings in Japan, Canada, Australia and Switzerland and plans to initiate additional filings in other countries in 2017.

About SMA [2-6]

Spinal muscular atrophy (SMA) is characterized by loss of motor neurons in the spinal cord and lower brain stem, resulting in severe and progressive muscular atrophy and weakness. Ultimately, individuals with the most severe type of SMA can become paralyzed and have difficulty performing the basic functions of life, like breathing and swallowing.

Due to a loss of, or defect in, the *SMN1* gene, people with SMA do not produce enough survival motor neuron (SMN) protein, which is critical for the maintenance of motor neurons. The severity of SMA correlates with the amount of SMN protein. People with Type 1 SMA, the form that requires the most intensive and supportive care, produce very little SMN protein and do not achieve the ability to sit without support or live beyond two years without respiratory support. People with Type 2 or Type 3 SMA produce greater amounts of SMN protein and have less severe, but still life-altering forms of SMA.

To support awareness and education about SMA, Biogen has launched Together in SMA in the United States and Japan. Together in SMA is a program created to provide informational materials and resources to the SMA community. Learn more at www.TogetherinSMA.com (U.S.-only) and www.TogetherinSMA.jp/ (Japan-only).

About SPINRAZA™ (nusinersen)

SPINRAZA is being developed globally for the treatment of SMA.

SPINRAZA is an antisense oligonucleotide (ASO), using Ionis Pharmaceuticals' proprietary antisense technology, that is designed to treat SMA caused by mutations or deletions in the *SMN1* gene located in chromosome 5q that leads to SMN protein deficiency. SPINRAZA alters the splicing of *SMN2* pre-mRNA in order to increase production of full-length SMN protein.[7] ASOs are short synthetic strings of nucleotides designed to selectively bind to target RNA and regulate gene expression. Through use of this technology, SPINRAZA has the potential to increase the amount of full-length SMN protein in patients with SMA.

SPINRAZA is administered via intrathecal injection, which delivers therapies directly to the cerebrospinal fluid (CSF) around the spinal cord,[8] where motor neurons degenerate in patients with SMA due to insufficient levels of SMN protein.[9]

The most common adverse reactions reported for SPINRAZA were lower respiratory infection, upper respiratory infection and constipation. Serious adverse reactions of atelectasis were more frequent in SPINRAZA-treated patients. Coagulation abnormalities and thrombocytopenia, including acute severe thrombocytopenia, have been observed after administration of some antisense oligonucleotides. Individuals may be at increased risk of bleeding complications. Renal toxicity has been observed after administration of some antisense oligonucleotides. SPINRAZA is present in and excreted by the kidney.

For complete SPINRAZA U.S. prescribing information please visit www.SPINRAZA.com.

About Patient Support in the U.S.

As part of Biogen's commitment to patients and families living with SMA, the company has launched SMA360°™, which provides certain services that address nonmedical barriers to access in the U.S. These include logistical assistance, product education, insurance benefits investigations and financial assistance. A list of the SMA360° offerings is available at www.SPINRAZA.com.

SMA360° services from Biogen are available only to those eligible patients who have been prescribed SPINRAZA in the U.S. To learn more about the program and receive additional information about these services, please contact an SMA Support Coordinator at 1-844-4SPINRAZA (1-844-477-4672) Monday-Friday 8:30 a.m.-8:00 p.m. EST.

About Biogen

Through cutting-edge science and medicine, Biogen discovers, develops and delivers innovative therapies worldwide for people living with serious neurological and neurodegenerative diseases. Founded in 1978, Biogen is a pioneer in biotechnology and today the Company has the leading portfolio of medicines to treat multiple sclerosis, has introduced the first and only approved treatment for spinal muscular atrophy, and is at the forefront of neurology research for conditions including Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis. Biogen also manufactures and commercializes biosimilars of advanced biologics. For more information, please visit www.biogen.com. Follow us on social media – Twitter, LinkedIn, Facebook, YouTube.

Biogen Safe Harbor

This press release contains forward-looking statements, including statements relating to the potential benefits, safety and efficacy of SPINRAZA, the status of current regulatory filings, and plans for additional regulatory filings in other jurisdictions. These statements may be identified by words such as "believe," "except," "may," "plan," "potential," "will" and similar expressions, and are based on our current beliefs and expectations. You should not place undue reliance on these statements. These statements involve risks and uncertainties that could cause actual results to differ materially from those reflected in such statements, including uncertainty of success in commercialization of SPINRAZA, which may be impacted by, among other things, the level of preparedness of healthcare providers to treat patients, difficulties in obtaining or changes in the availability of reimbursement for SPINRAZA, the effectiveness of sales and marketing efforts, problems with the manufacturing process for SPINRAZA, the occurrence of adverse safety events, failure to obtain regulatory approvals in other jurisdictions, failure to protect intellectual property and other proprietary rights, product liability claims, third party collaboration risks, and the other risks and uncertainties that are described in the Risk Factors section of Biogen's most recent annual or quarterly report and in other reports Biogen has filed with the U.S. Securities and Exchange Commission (SEC). Any forward-looking statements speak only as of the date of this press release and we assume no obligation to update any forward-looking statement.

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