J.P. Morgan 2019 Healthcare Conference

Michel Vounatsos, Chief Executive Officer

January 7, 2019

Forward looking statements

This presentation contains forward-looking statements, including statements relating to Biogen's strategy and plans; corporate strategy update; potential of our commercial business and pipeline programs; the prospects of our product portfolio; pipeline potential and progress; anticipated clinical trials and data readouts; regulatory filings, product launches, and the timing thereof; reimbursement activities; anticipated benefits and potential of investments, collaborations, and business development activities; the timing and execution of stock repurchases; our future financial and operating results; and other financial matters. These forward-looking statements may be accompanied by such words as "aim," "anticipate," "believe," "could," "estimate," "expect," "forecast," "goal," "intend," "may," "plan," "potential," "possible," "will," and other words and terms of similar meaning. Drug development and commercialization involve a high degree of risk, and only a small number of research and development programs result in commercialization of a product. Results in early stage clinical trials may not be indicative of full results or results from later stage or larger scale clinical trials and do not ensure regulatory approval. You should not place undue reliance on these statements or the scientific data presented.

These statements involve risks and uncertainties that could cause actual results to differ materially from those reflected in such statements, including: our dependence on revenues from our principal products; failure to compete effectively due to significant product competition in the markets for our products; difficulties in obtaining and maintaining adequate coverage, pricing, and reimbursement for our products; the occurrence of adverse safety events, restrictions on use with our products, or product liability claims; failure to protect and enforce our data, intellectual property, and other proprietary rights, and the risks and uncertainties relating to intellectual property claims and challenges; uncertainty of long-term success in developing, licensing, or acquiring other product candidates or additional indications for existing products; the risk that positive results in a clinical trial may not be replicated in subsequent or confirmatory trials or success in early stage clinical trials may not be predictive of results in later stage or large scale clinical trials or trials in other potential indications; risks associated with clinical trials, including our ability to adequately manage clinical activities, unexpected concerns that may arise from additional data or analysis obtained during clinical trials, regulatory authorities may require additional information or further studies, or may fail to approve or may delay approval of our drug candidates; risks associated with current and potential future healthcare reforms; problems with our manufacturing processes; risks relating to technology failures or breaches; our dependence on collaborators and other third parties for the development, regulatory approval, and commercialization of products and other aspects of our business, which are outside of our full control; failure to successfully execute on our growth initiatives; risks relating to management and key personnel changes, including attracting and retaining key personnel; risks relating to investment in and expansion of manufacturing capacity for future clinical and commercial requirements; failure to comply with legal and regulatory requirements; fluctuations in our effective tax rate; the risks of doing business internationally, including currency exchange rate fluctuations; risks related to commercialization of biosimilars; risks related to investment in properties; the market, interest, and credit risks associated with our portfolio of marketable securities; risks relating to stock repurchases; risks relating to access to capital and credit markets; risks related to indebtedness; environmental risks; risks relating to the sale and distribution by third parties of counterfeit versions of our products; risks relating to the use of social media for our business; change in control provisions in certain of our collaboration agreements; risks relating to the spin-off of our hemophilia business, including risks of operational difficulties and exposure to claims and liabilities; and the other risks and uncertainties that are described in the Risk Factors section of our most recent annual or quarterly report and in other reports we have filed with the Securities and Exchange Commission.

These statements are based on our current beliefs and expectations and speak only as of the date of this presentation. We do not undertake any obligation to publicly update any forward-looking statements.

Capturing the opportunity

Driving results

Building momentum

Capturing the opportunity

Driving results

Building momentum

Significant opportunity in neuroscience continues to grow

#1 **Cause of disability** globally

#2 **Cause of deaths** worldwide

~72M patients with dementia

~10M patients with Parkinson's disease

~2.5M patients with multiple sclerosis

Spinal muscular atrophy: A **leading genetic cause of infant mortality**

<5 years average life expectancy for patients with ALS

Stroke: **5th leading cause of death** in the U.S.

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Source: Lancet Neurology, 2017; DRG 2017, American Heart Association, American Parkinson's Disease Association, The ALS Association.

Strong core business and investing for future growth

Executing on the core business

- **Maximizing the resilience of our MS core business**
- **Accelerating progress in spinal muscular atrophy**
- **Creating a leaner and simpler operating model**

+

Creating new sources of value

- **Developing and expanding our neuroscience portfolio**
- **Re-prioritizing our capital allocation efforts**

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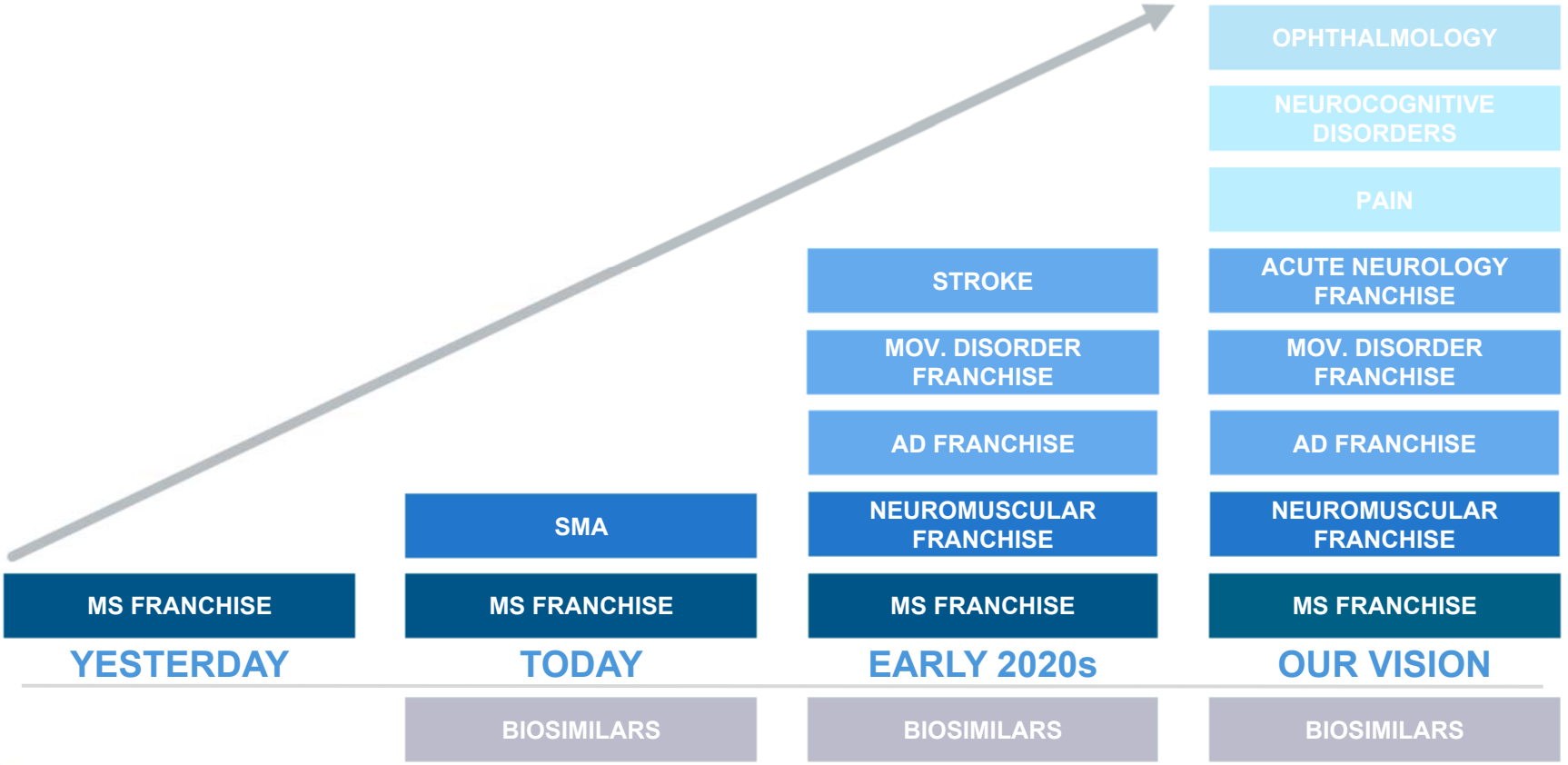
Continuing to build a multi-franchise neuroscience portfolio



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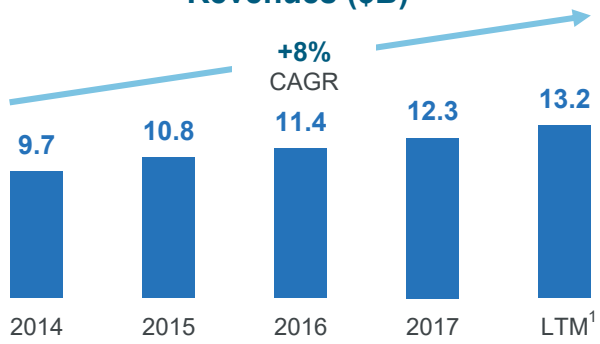
Capturing the opportunity

Driving results

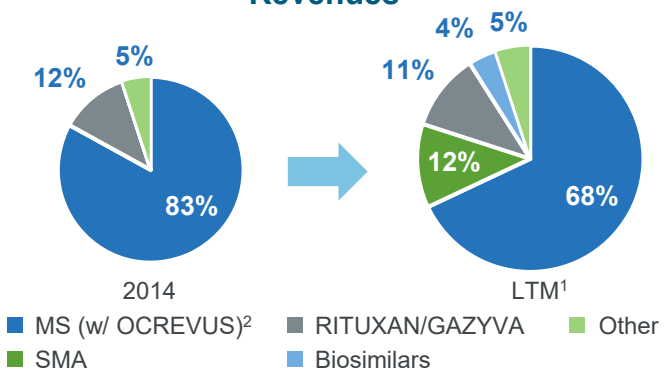
Building momentum

Strong financial track record

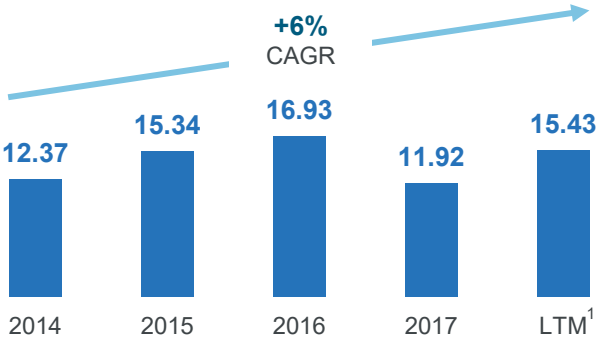
Revenues ($B)



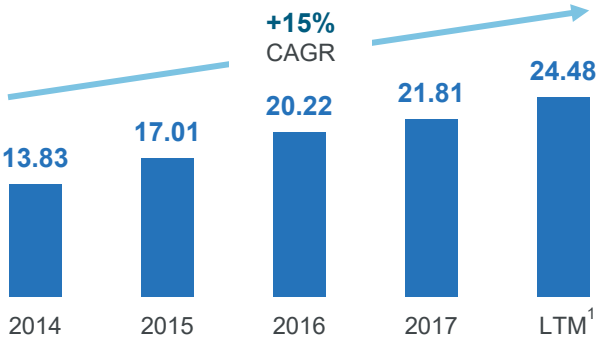
Revenues



GAAP diluted EPS ($)



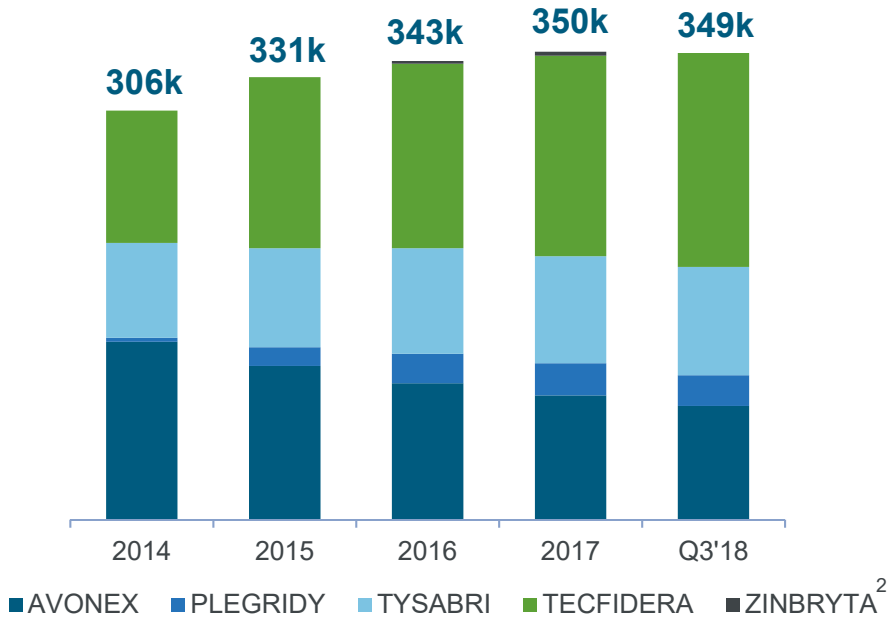
Non-GAAP diluted EPS ($)



1. LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.
2. Includes royalties on the sales of OCREVUS, which began in 2017.
A reconciliation of our GAAP to non-GAAP financial results is at the end of this presentation.

Demonstrated resilience in our $9 billion MS franchise

Biogen MS patients



Highlights

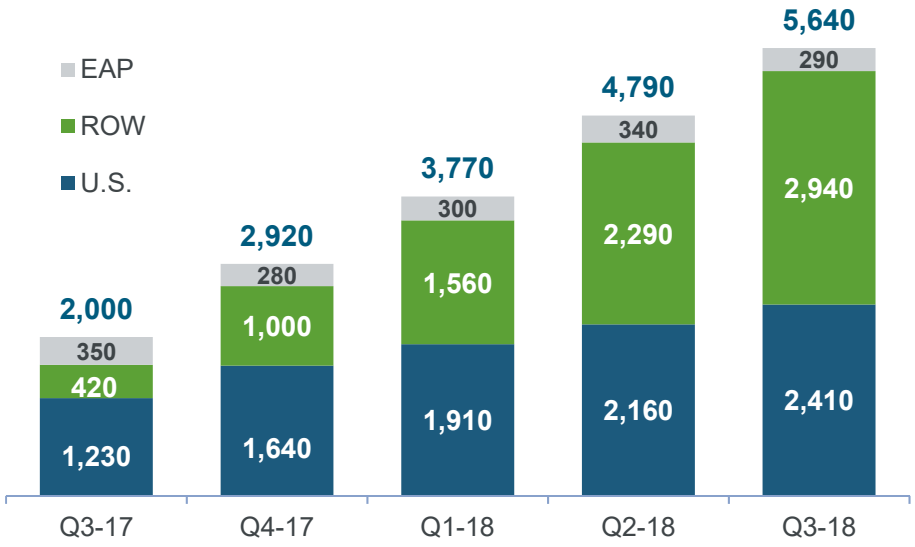
- > $20B market with ~ 1 million treated MS patients worldwide[1]
- Biogen products treat ~35% of all treated MS patients globally[1]
- **VUMERITY (BIIB098)**[3] is a potential novel oral option – now filed with FDA
- Reinvigorating our MS R&D strategy, with the goals of:
  - Developing transformative therapies for relapsing MS
  - Advancing care in progressive disease
  - Improving disability and restoring function

Note: Patient numbers represent estimated ending patient count as of December 31st of each year, except for 2018 which represents patients as of September 30, 2018.

1. Biogen data on file as of September 30, 2018
2. ZINBRYTA was withdrawn from the market in March 2018
3. In collaboration with Alkermes. The brand name VUMERITY has been conditionally accepted by FDA and will be confirmed upon approval.

Blockbuster global launch of SPINRAZA, driven by global expansion

SPINRAZA patients*



Biogen built the SMA market

Highlights

- LTM[1] Revenues of **$1.6 Billion**
- **~ 6,000 patients** on therapy*
  - ~ 20,000 SMA patients across U.S., Europe, and Japan with additional opportunity in other markets
  - Formal reimbursement in 30 countries[2]
- First and only approved treatment, with proven efficacy across all patient types and a well characterized safety profile
- **Broad label and largest body of data in SMA**
- **Investing in SMA beyond SPINRAZA, pursuing:**
  - Muscle enhancement (BIIB110, Phase 1)
  - Novel ASO drug candidates
  - New preclinical oral splicing modulator
  - Optimizing ASO dosing/delivery

* Note: U.S. and Ex-US SPINRAZA patients represent the total number of patients on therapy in the post-marketing setting as of the end of each quarter, including free patients in the U.S. EAP patients represent patients actively enrolled in the Expanded Access Program (EAP) as of the end of each quarter. As of the end of Q3-18, there were an additional ~ 300 patients enrolled in ongoing clinical studies of SPINRAZA.

1. LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.

2. As of January 4, 2019.

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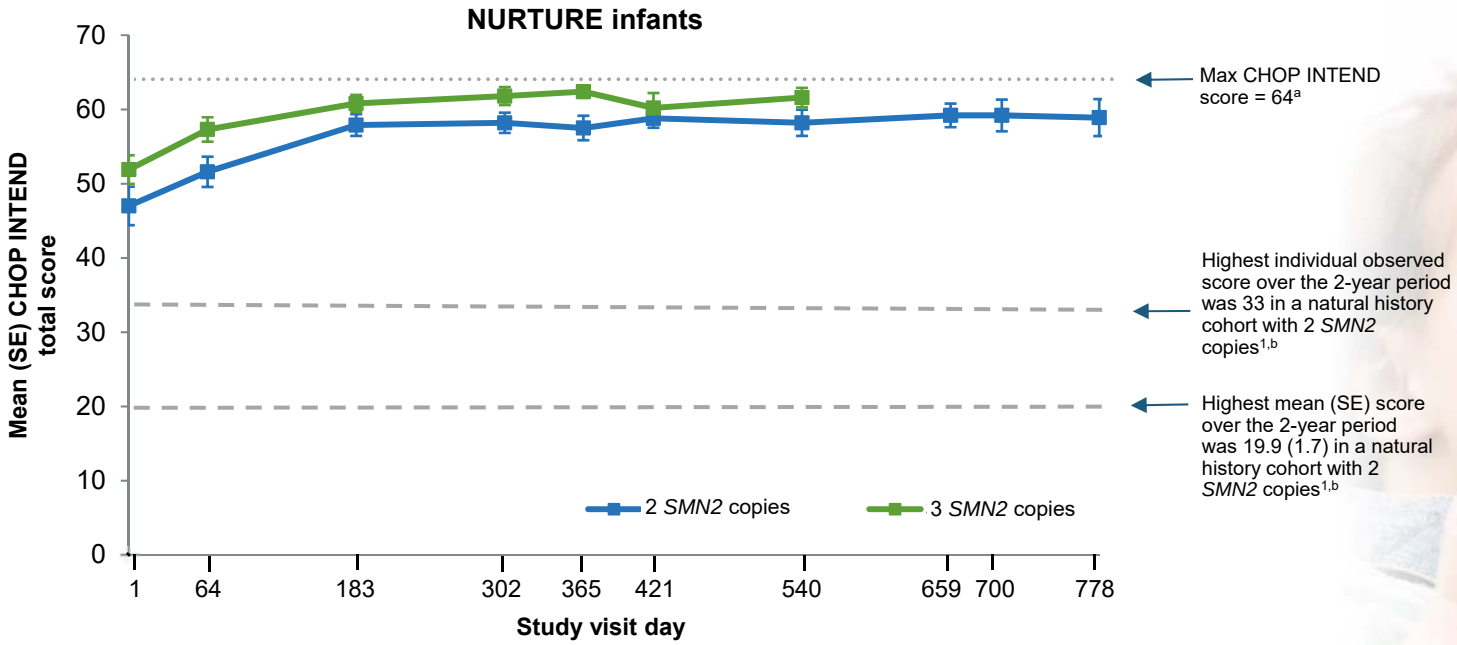
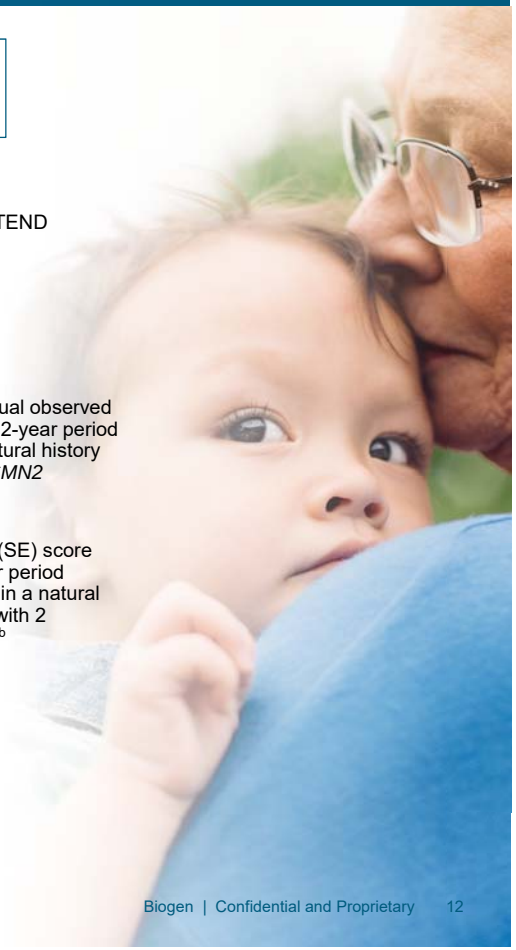
SPINRAZA: the standard of care with unprecedented efficacy

NURTURE study in pre-symptomatic infants

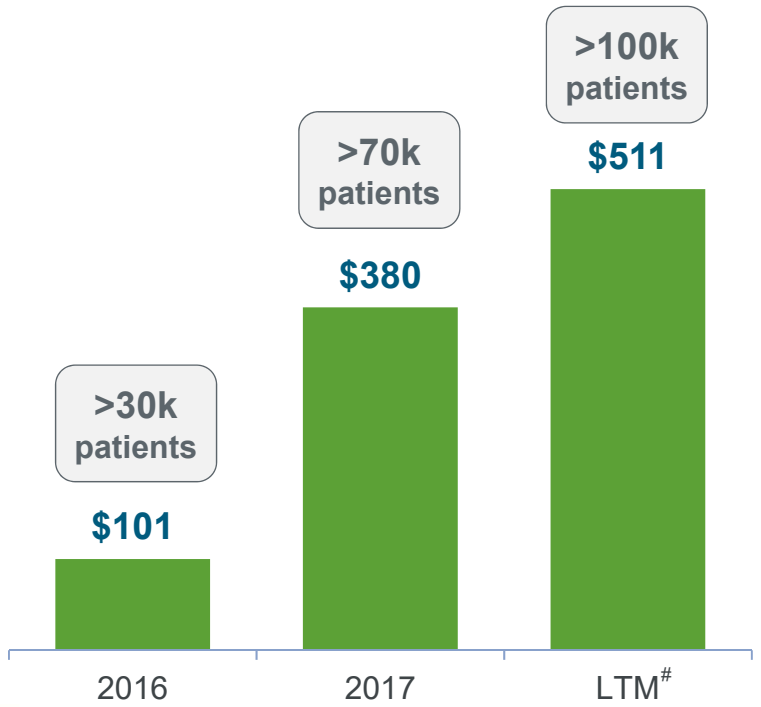




NURTURE study interim analysis data cutoff date: May 15, 2018. Time points with n≥5 included. [a]Per version 6 of the study protocol, CHOP INTEND was assessed in participants until they have a maximum score of 64. Once a score of 64 is achieved, CHOP INTEND will no longer be assessed. [b]Infants were aged ≤6 months at enrollment, born between 36 and 42 weeks' gestation, and had genetically confirmed SMA; infants were excluded if they required noninvasive ventilatory support for >12 hours/day, had a comorbid illness, or were enrolled in a SMA clinical trial. 1. Kolb SJ, *et al*; NeuroNEXT Clinical Trial Network on behalf of the NN101 SMA Biomarker Investigators. *Ann Neurol*. 2017;82(6):883-891.

Growing biosimilars business that can create headroom for innovation

BENEPALI and FLIXABI (revenues $M)



SAMSUNG BIOEPIS

COMMERCIALIZATION IN EUROPE

- > 100,000 patients currently on Biogen biosimilars*
- BENEPALI uptake has led to estimated healthcare savings of up to €800 million annually across Europe*
- IMRALDI launched in Europe on October 17, 2018

SAMSUNG BIOEPIS JOINT VENTURE

- Increased equity stake to ~49.9%
- Leveraging expertise in protein engineering and biologics manufacturing
- Advancing biosimilars of trastuzumab and bevacizumab

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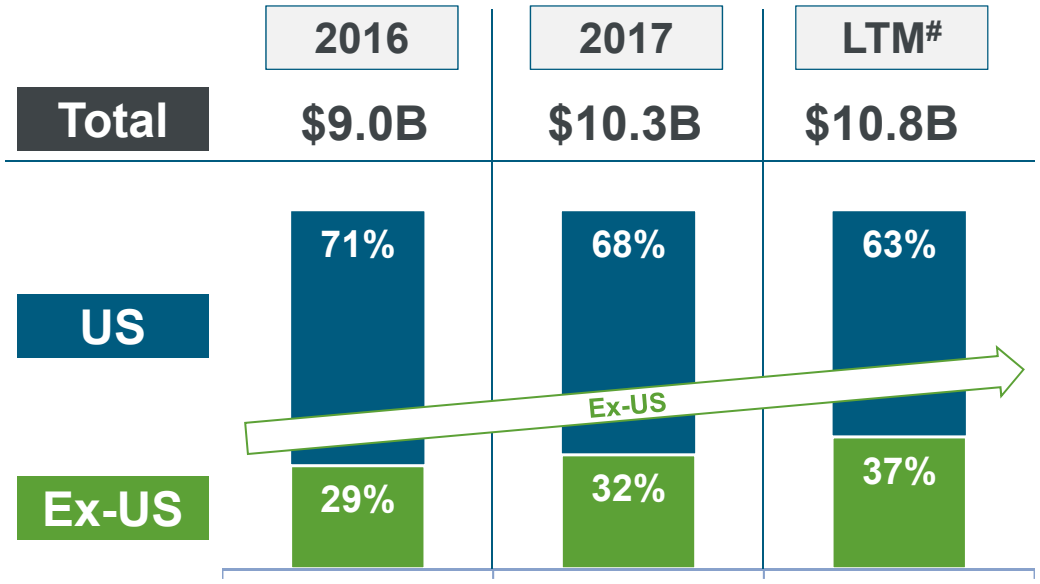
* Biogen data on file.
# LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.

Capitalizing on global growth opportunities

Biogen product revenues, net*



Expanding into new markets**

- Increasing footprint in Asia
  - China
  - Korea
  - Taiwan
  - Hong Kong
- Growing presence in LATAM
  - Colombia
  - Mexico

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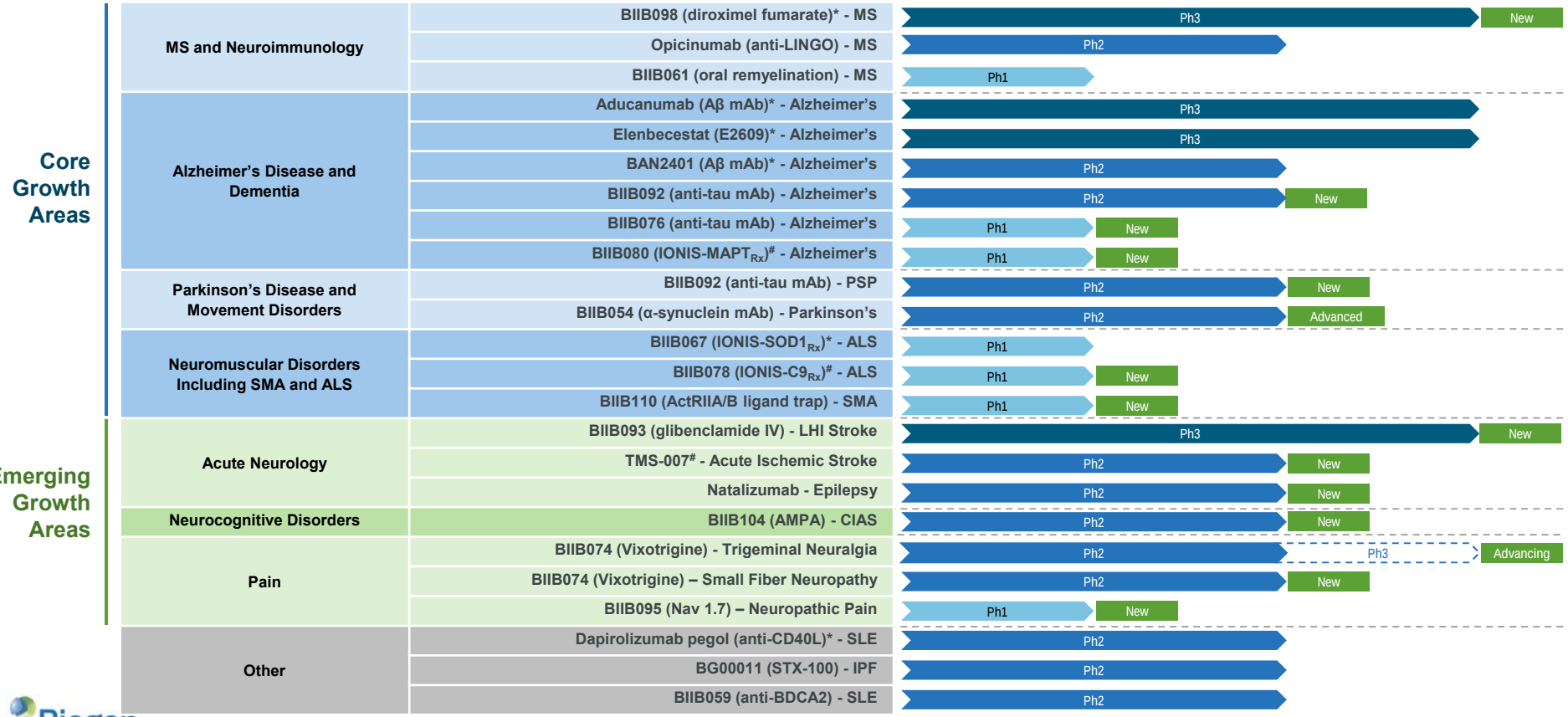
* Total net product revenues reported on a GAAP basis were $9.8 billion and $10.4 billion for the years ended December 31, 2016 and 2017, respectively. Amounts presented in table above exclude hemophilia product revenues for 2016 and 2017.
** New affiliates after January 2017
# LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.

Added or advanced 14 clinical programs since beginning of 2017



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* Collaboration programs # Option agreement

Positive phase 1 results for BIIB067 in SOD1 ALS

BIIB067 (SOD1 ASO)

- In SOD1 ALS, genetic mutations in SOD1 result in production of toxic protein
- Interim data from multiple ascending dose study recently demonstrated both **proof-of-biology and proof-of-concept**
- **Planning to add additional cohort with potential to support registration**
- **Exercised option** to obtain license from Ionis Pharmaceuticals to develop, manufacture, and commercialize
- Potential positive implications for our **growing ASO portfolio** with Ionis

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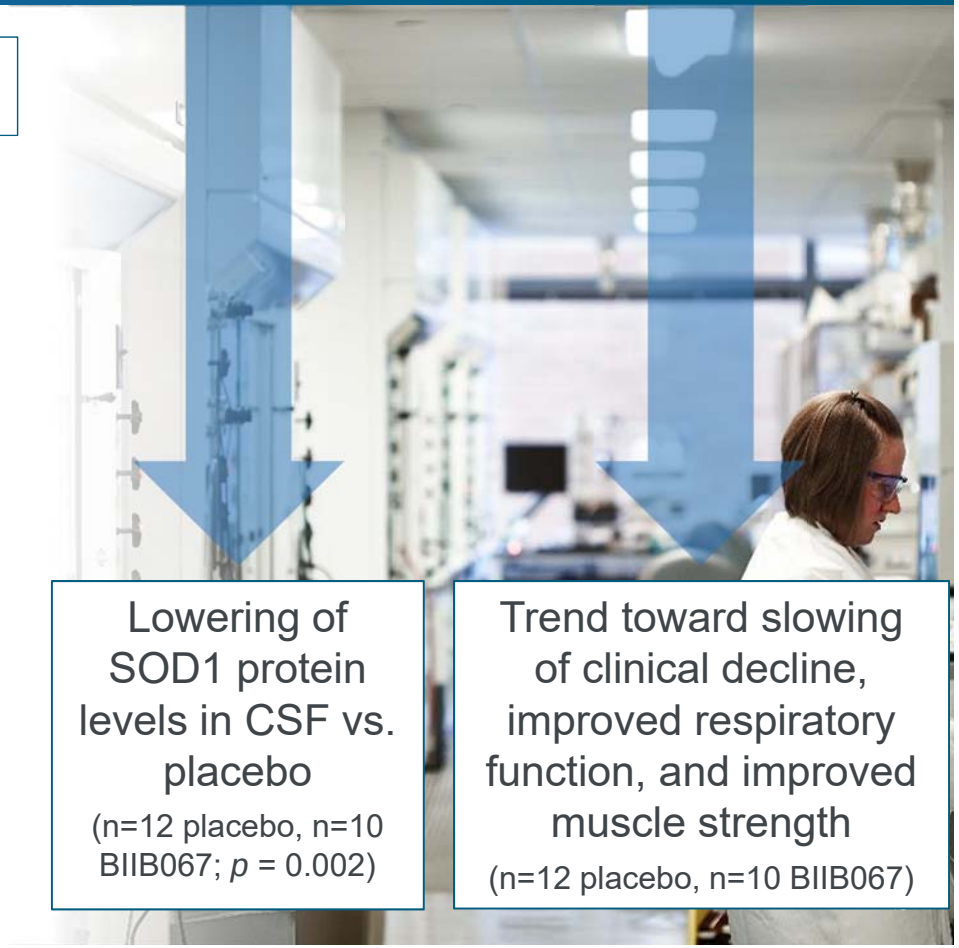
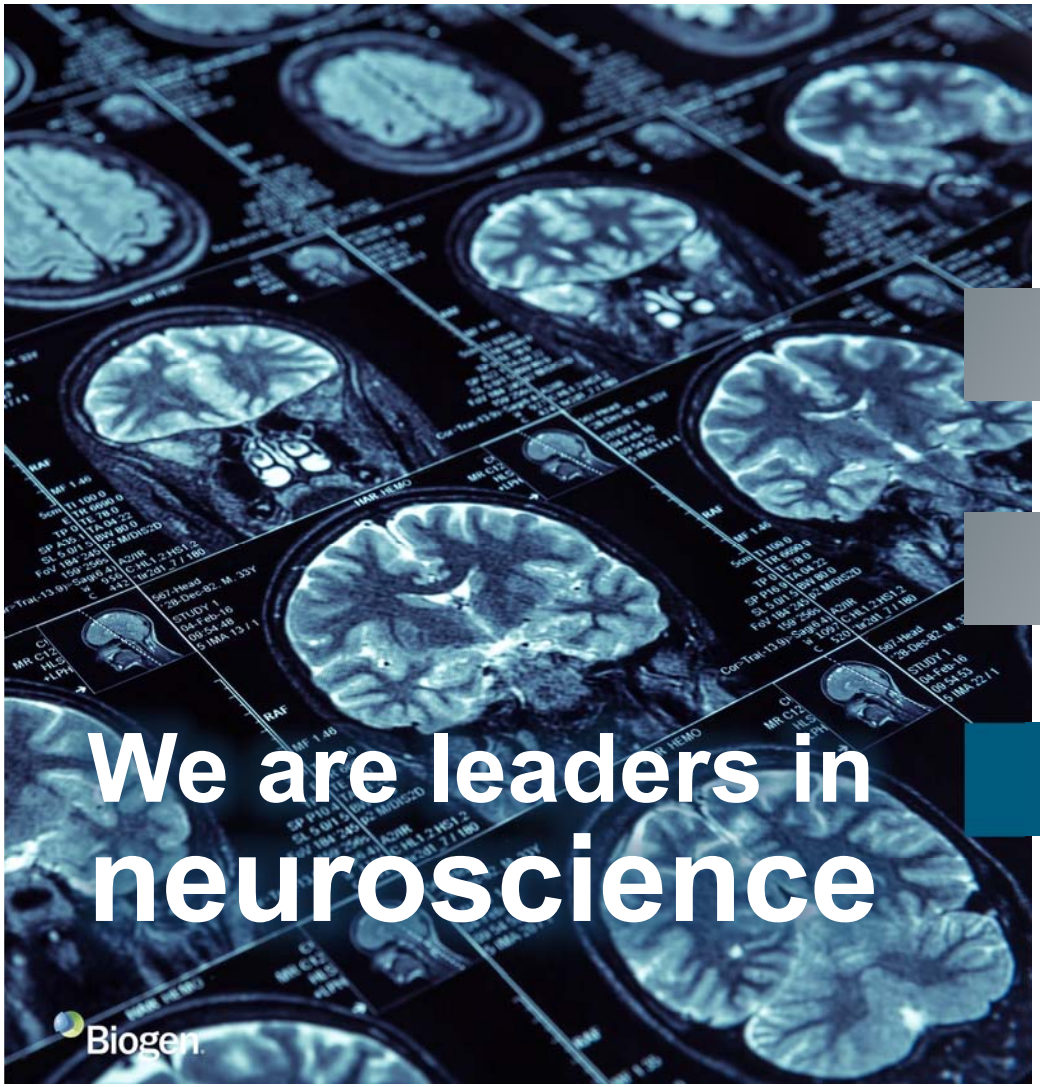


Lowering of SOD1 protein levels in CSF vs. placebo

(n=12 placebo, n=10 BIIB067; p = 0.002)

Trend toward slowing of clinical decline, improved respiratory function, and improved muscle strength

(n=12 placebo, n=10 BIIB067)

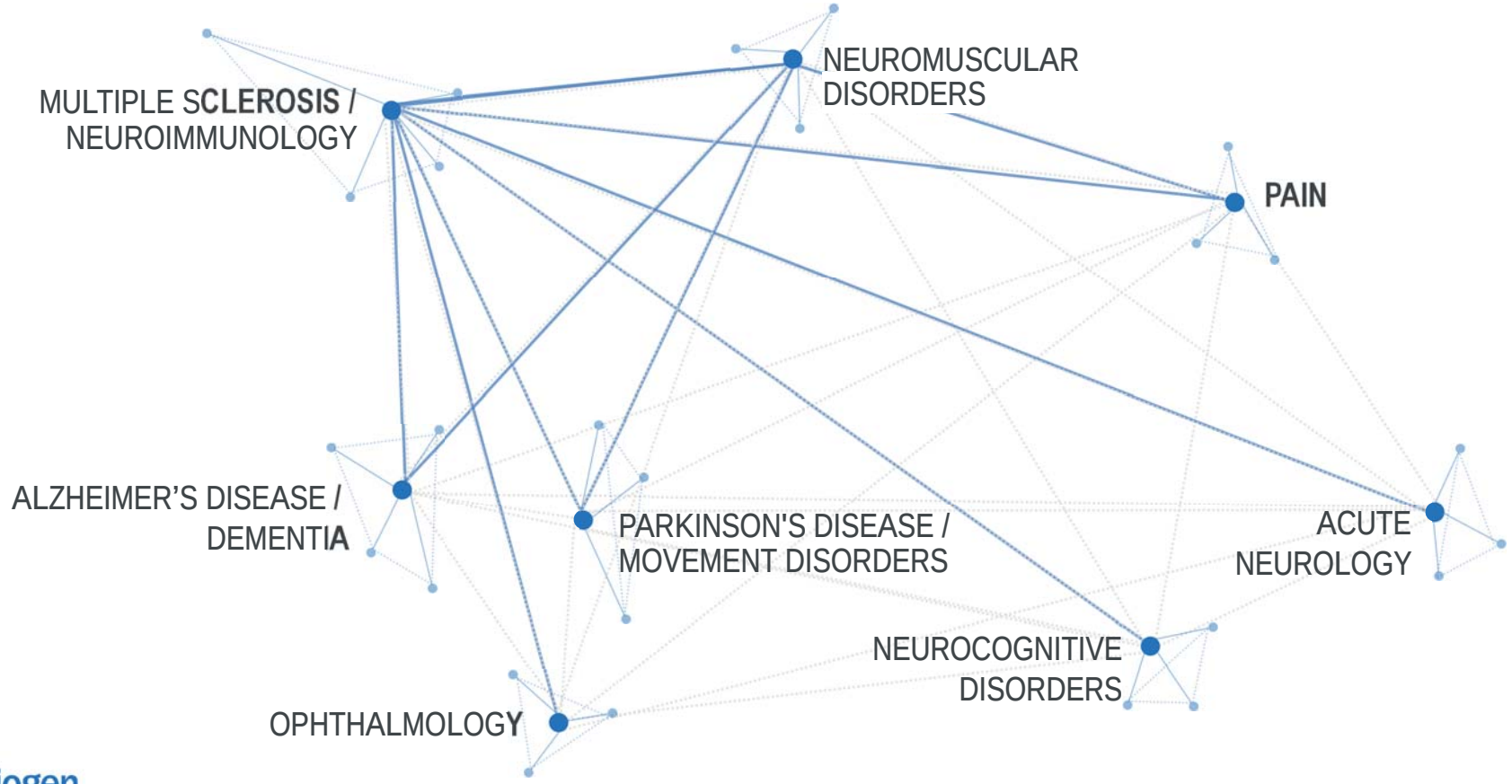


Capturing the opportunity

Driving results

Building momentum

Leveraging the connections between disease areas



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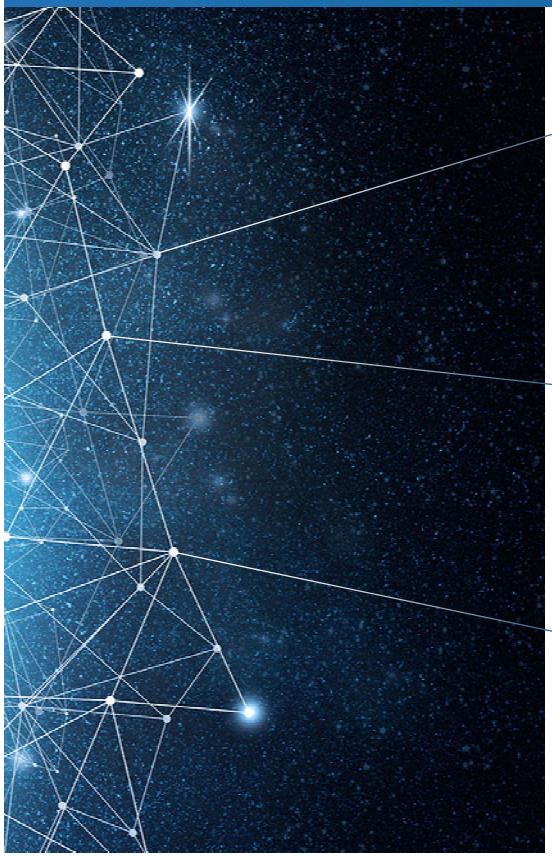
Scientific hypotheses underlie and connect our pipeline



ASO ENGINEERING
ASOs succeed beyond SMA, with broad utility across genetic targets and diseases in CNS

Neuromuscular
AD & Dementia
Movement Disorders

TAU
Targeting tau slows or halts disease progression in tauopathies

Movement Disorders
AD & Dementia

ALPHA-SYNUCLEIN
Targeting alpha-synuclein slows or halts disease progression in Parkinson's disease

Movement Disorders

Biogen

Building depth in neuromuscular disorders

Spinal Muscular Atrophy (SMA)

Amyotrophic Lateral Sclerosis (ALS)

Other potential areas of interest:

Duchenne Muscular Dystrophy

Myotonic Dystrophy

Charcot-Marie-Tooth Peripheral Neuropathies

Sarcopenia

Facioscapulohumeral Muscular Dystrophy

Investing beyond SPINRAZA

- Muscle enhancement, novel ASO drug candidates, new preclinical oral splicing modulator, optimizing ASO dosing/delivery

BIIB067 (SOD1 ASO)

- Phase 1 interim data demonstrated both **proof-of-biology and proof-of-concept**
- **Planning to add additional cohort with potential to support registration**

BIIB078 (C9orf72 ASO)*

- Targeting the most common genetic cause of ALS
- Recently **initiated Phase 1 study**

BIIB100 (small molecule XPO1 inhibitor)

- Targeting sporadic ALS (~ 90% of cases)
- Planning to **initiate Phase 1 study in 1H:19**

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* Biogen has an option to license BIIB078 from Ionis Pharmaceuticals

Strong momentum in movement disorders

Progressive Supranuclear Palsy (PSP)

Parkinson's Disease (PD)

Other potential areas of interest:

Huntington's Disease

Ataxias

Multiple System Atrophy (MSA)

BIIB092 in PSP

- PSP is a devastating rare disease, believed to be cause by accumulation of tau protein
- In a Phase 1 study BIIB092 demonstrated **> 90% reduction in CSF free eTau**
- **Phase 2 data expected 2H:19; potential to file if data are positive**

BIIB054 in Parkinson's Disease

- Targets spreading of α-Synuclein, believed to play a major role in Parkinson's disease
- Currently enrolling **Phase 2 study**

Multiple Preclinical Programs

- Expect up to two assets to enter the clinic in 2019

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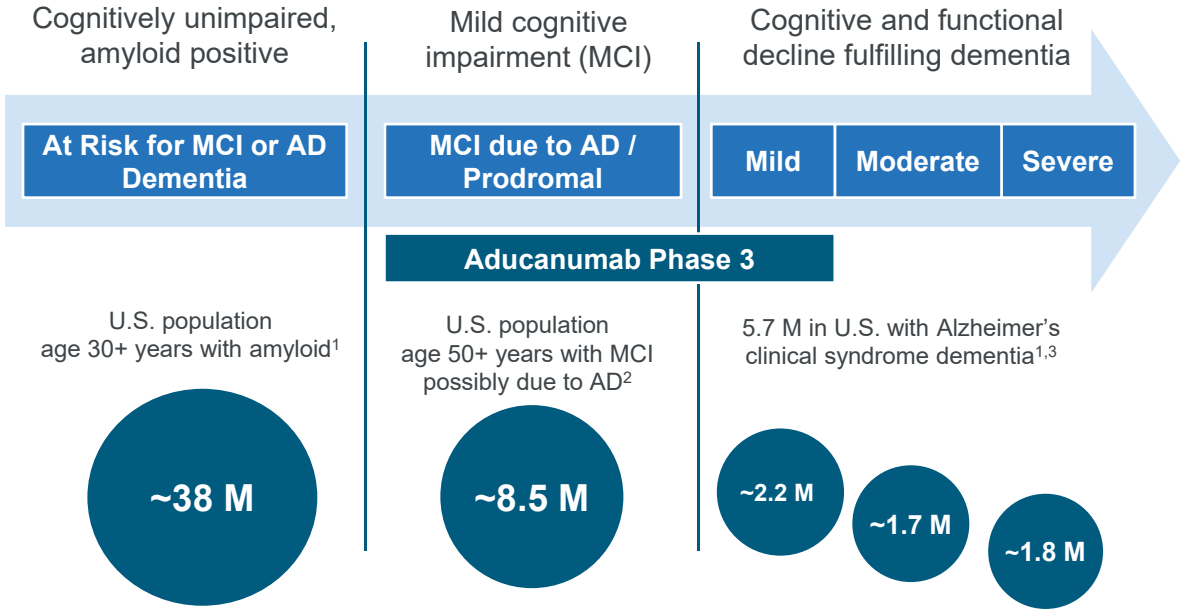
Advancing our differentiated and industry-leading Alzheimer's portfolio

U.S. Epidemiology



Aducanumab Phase 3 Anti-amyloid antibody AMYLOID PATHWAY	**Elenbecestat[4] (E2609)** Phase 3 Oral inhibitor of β secretase REDUCE AMYLOID PRODUCTION
BAN2401 Phase 2 Anti-amyloid antibody AMYLOID PATHWAY	**BIIB092** Phase 2 Anti-tau antibody REDUCE SPREAD OF TAU
BIIB076 Phase 1 Anti-tau antibody REDUCE SPREAD OF TAU	**BIIB080** Phase 1 Antisense oligonucleotide REDUCE PRODUCTION OF TAU

- Final data for **aducanumab** expected in early 2020
- Recent data for **BAN2401** provide further support for amyloid hypothesis

1. Alzheimer's Association Facts & Figures 2018.
2. Petersen et al 2018 Neurology; Knopman et al 2016 Alz & Dement.
3. Hebert et al. 2003 Arch Neurol; Alzheimer's Association Changing the Trajectory of Disease 2015.
4. Generic name to be confirmed.

Note: Aducanumab, elenbecestat, and BAN2401 are being developed in collaboration with Eisai. Biogen has an option to license BIIB080 from Ionis Pharmaceuticals.

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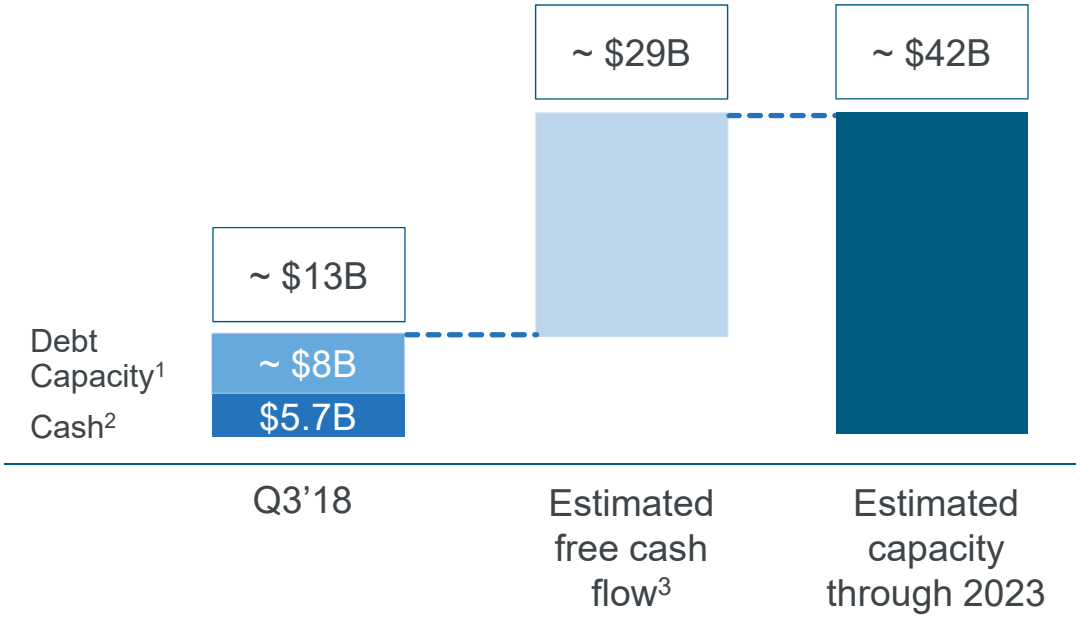
Potential significant opportunity for capital allocation

For illustrative purposes only



Potential uses of cash

- Business development / M&A
- Share repurchases

A reconciliation of our GAAP to non-GAAP financial results is at the end of this presentation.

1. Debt capacity estimate based on gross debt of 2x EBITDA, less current debt outstanding.
2. Cash, cash equivalents, and marketable securities.
3. Free cash flow is defined as cash flow from operations, less capital expenditures and less estimated remaining contingent consideration related to the Fumapharm AG acquisition. Cash flow from operations estimated by extrapolating LTM cash flows through 2023. LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.

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Capturing the opportunity

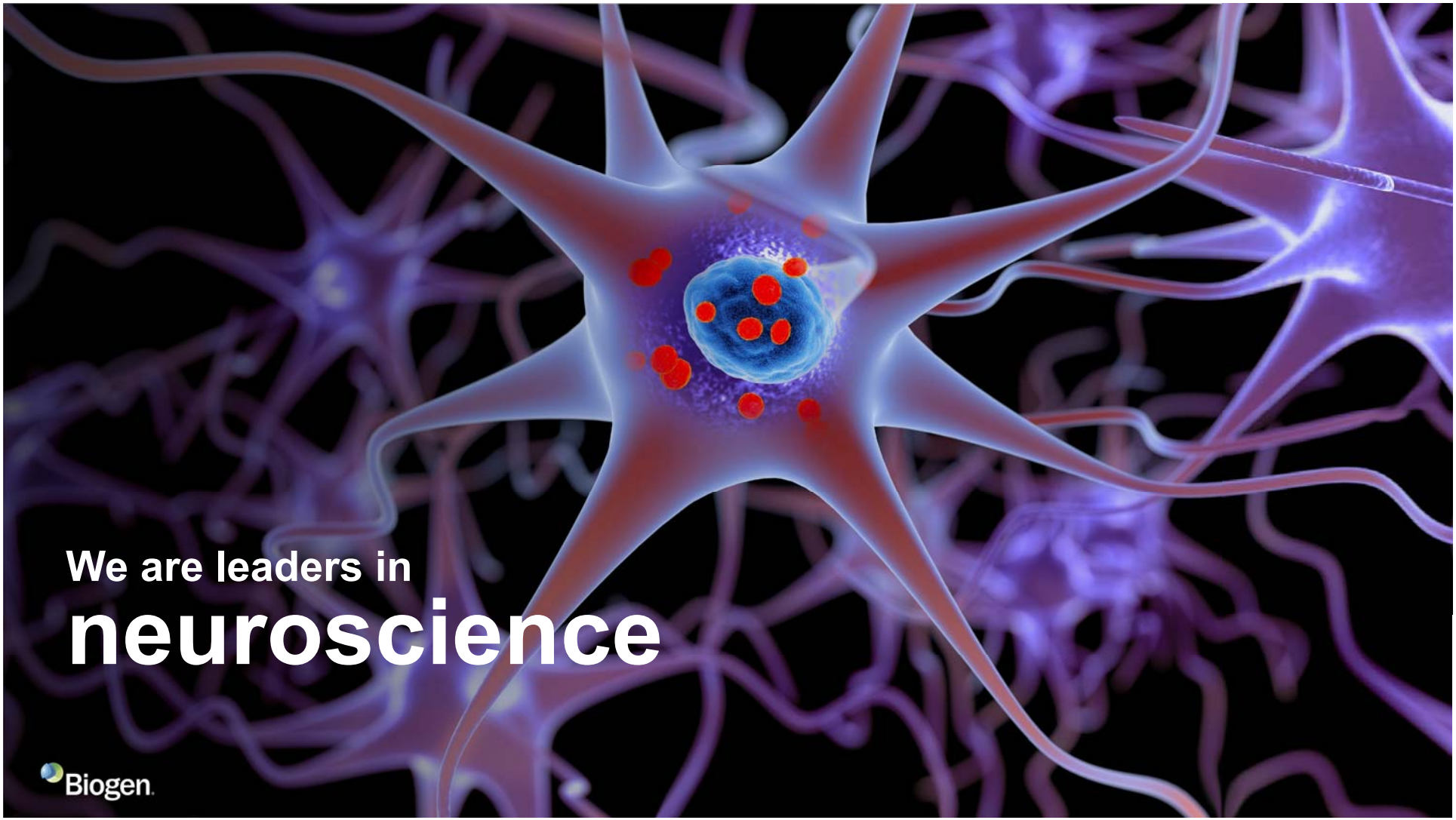
- Unmet need in neuroscience is massive
- Breaking science
- Diversified and integrated neuroscience pipeline

Driving results

- Growing global franchises
- Added/advanced 14 clinical programs since 2017
- Implementing lean and simple operating model

Building momentum

- Leveraging the interconnectivity of neurological diseases
- Driving depth in disease areas beyond AD
- Data readouts expected across multiple disease areas over the next 12-18 months


We are leaders in
neuroscience
Biogen

GAAP to non-GAAP reconciliation

Diluted EPS and Net Income to Biogen Inc.

(Unaudited, $ in millions, except per share amounts)

	FY 2014	FY 2015	FY 2016	FY 2017	LTM
GAAP EPS - Diluted	$ 12.37	$ 15.34	$ 16.93	$ 11.92	$ 15.43
Adjustment to net income attributable to Biogen Inc. (see below)	1.46	1.67	3.29	9.89	9.05
Non-GAAP EPS - Diluted	$ 13.83	$ 17.01	$ 20.22	$ 21.81	$ 24.48
GAAP Net Income Attributable to Biogen Inc.	$ 2,935	$ 3,547	$ 3,703	$ 2,539	$ 3,187
Amortization of acquired intangible assets [A,B]	473	365	374	815	633
TECFIDERA litigation settlement charge [A]	-	-	455	-	-
Acquired in-process research and development	-	-	-	120	113
(Gain) loss on fair value remeasurement of contingent consideration [C]	(39)	31	15	63	(90)
Premium paid on purchase of Ionis common stock [D]	-	-	-	-	162
(Gain) loss on equity security investments	-	-	-	-	(140)
Net distribution to noncontrolling interests [E]	-	-	-	132	178
(Gain) loss on deconsolidation of variable interest entities	-	-	(4)	-	-
Restructuring, business transformation and other cost saving initiatives					-
2017 corporate strategy implementation [F]	-	-	-	19	29
Restructuring charges [G]	-	93	33	1	10
Cambridge manufacturing facility rationalization costs [H]	-	-	55	-	-
Hemophilia business separation costs	-	-	18	19	-
Donation to Biogen Foundation	35	-	-	-	-
Stock option expense and other	12	-	-	-	-
Income tax effect related to reconciling items	(135)	(104)	(225)	(236)	(150)
Tax reform [I]	-	-	-	1,174	1,163
Non-GAAP Net Income Attributable to Biogen Inc.	$ 3,281	$ 3,932	$ 4,423	$ 4,645	$ 5,094

Free Cash Flow Reconciliation

(unaudited, $ in millions)

	LTM	Q4 2018 - 2023
Net cash flows provided by operating activities	$ 5,811	$ 30,506
Purchases of property, plant and equipment (Capital Expenditures)	775	1,575
Contingent consideration paid related to Fumapharm AG acquisition	1,500	300
Free Cash Flow	$ 3,535	$ 28,631

Use of Non-GAAP Financial Measures

We supplement our consolidated financial statements presented on a GAAP basis by providing additional measures which may be considered "Non-GAAP" financial measures under applicable SEC rules. We believe that the disclosure of these Non-GAAP financial measures provides additional insight into the ongoing economics of our business and reflects how we manage our business internally, set operational goals and form the basis of our management incentive programs. These Non-GAAP financial measures are not in accordance with generally accepted accounting principles in the United States and should not be viewed in isolation or as a substitute for reported, or GAAP, net income attributable to Biogen Inc. and diluted earnings per share.

Our "Non-GAAP net income attributable to Biogen Inc." and "Non-GAAP earnings per share - Diluted" financial measures exclude the following items from "GAAP net income attributable to Biogen Inc." and "GAAP earnings per share - Diluted":

1. Purchase accounting, merger-related and other adjustments
We exclude certain purchase accounting related items associated with the acquisition of businesses, assets and amounts in relation to the consolidation or deconsolidation of variable interest entities for which we are the primary beneficiary. These adjustments include, but are not limited to, charges for in-process research and development and certain milestones, the amortization of intangible assets, and charges or credits from the fair value remeasurement of our contingent consideration obligations.

2. Hemophilia business separation costs
We have excluded costs that are directly associated with the set up and spin-off of our hemophilia business on February 1, 2017. These costs represent incremental third-party costs attributable solely to hemophilia separation and set up activities.

3. Restructuring, business transformation and other cost saving initiatives
We exclude costs associated with our execution of certain strategies and initiatives to streamline operations, achieve targeted cost reductions, rationalize manufacturing facilities, or refocus R&D activities. These costs may include employee separation costs, retention bonuses, facility closing and exit costs, asset impairment charges or additional depreciation when the expected useful life of certain assets have been shortened due to changes in anticipated usage, and other costs or credits that management believes do not have a direct correlation to our on-going or future business operations.

4. (Gain) loss on equity security investments
Effective January 2018 we exclude unrealized and realized gains and losses and discounts or premiums on our equity security investments as we do not believe that these components of income or expense have a direct correlation to our on-going or future business operations.

5. Other items
We evaluate other items of income and expense on an individual basis and consider both the quantitative and qualitative aspects of the item, including (i) its size and nature, (ii) whether or not it relates to our ongoing business operations, and (iii) whether or not we expect it to occur as part of our normal business on a regular basis. We also include an adjustment to reflect the related tax effect of all reconciling items within our reconciliation of our GAAP to Non-GAAP net income attributable to Biogen Inc. and diluted earnings per share.

Free Cash Flow

Free cash flow is defined as cash flow from operations, less capital expenditures and less estimated remaining contingent consideration related to the Fumapharm AG acquisition. Net cash flows provided by operating activities for the period Q4 2018 – 2023 were estimated by extrapolating LTM cash flows through 2023.

Numbers may not foot due to rounding.

LTM = last 12 months prepared based upon the sum of reported amounts for the nine months ended September 30, 2018, and three months ended December 31, 2017.

GAAP to non-GAAP reconciliation

[A] In January 2017 we entered into a settlement and license agreement with Forward Pharma A/S (Forward Pharma), which was effective February 1, 2017. Pursuant to this agreement, we obtained U.S. and rest of world licenses to Forward Pharma's intellectual property, including Forward Pharma's intellectual property related to TECFIDERA. In exchange, we paid Forward Pharma $1.25 billion in cash.

During the fourth quarter of 2016, we recognized a pre-tax charge of $454.8 million and in the first quarter of 2017 we recognized an intangible asset of $795.2 million related to this agreement. The pre-tax charge recognized in the fourth quarter of 2016 represented the fair value of our licenses to Forward Pharma's intellectual property for the period April 2014, when we started selling TECFIDERA, through December 31, 2016. The intangible asset represented the fair value of the U.S. and rest of world licenses to Forward Pharma's intellectual property related to TECFIDERA revenues for the period January 2017, the month in which we entered into this agreement, through December 2020, the last month before royalty payments could first commence pursuant to this agreement.

We have two intellectual property disputes with Forward Pharma, one in the U.S. and one in the European Union, concerning intellectual property related to TECFIDERA. In March 2017 the U.S. intellectual property dispute was decided in our favor. We evaluated the recoverability of the U.S. asset acquired from Forward Pharma and recorded a $328.2 million impairment charge in the first quarter of 2017 to adjust the carrying value of the acquired U.S. asset to fair value reflecting the impact of the developments in the U.S. legal dispute. In March 2018 the European Patent Office (EPO) revoked Forward Pharma's European Patent No. 2 801 355. Forward Pharma has filed an appeal to the Technical Board of Appeal of the EPO and the appeal is pending. Based upon our assessment of these rulings, we continue to amortize the remaining new book value of the U.S. and rest of world intangible assets in our consolidated statements of income utilizing an economic consumption model.

Amortization of acquired intangible assets for the twelve months ended December 31, 2017, also includes a $31.2 million pre-tax impairment charge recognized in the fourth quarter of 2017 related to our acquired and in-licensed rights and patents intangible asset related to ZINBRYTA after the initiation of an European Medicines Agency review (referred to as an Article 20 Procedure) of ZINBRYTA following the report of a case of fatal fulminant liver failure, as well as four cases of serious liver injury.

[B] Amortization of acquired intangible assets for the LTM period includes a $31.2 million pre-tax impairment charge related to our acquired and in-licensed rights and patents intangible asset related to ZINBRYTA after the initiation of an Article 20 Procedure of ZINBRYTA recognized in the fourth quarter of 2017.

Amortization of acquired intangible assets for the LTM period also includes the impact of impairment charges related to certain in-process research and development (IPR&D) assets associated with our vixotrigine (BIIB074) program totaling $189.3 million that were recognized during the nine months ended September 30, 2018. During the third quarter of 2018 we completed a Phase 2b study for vixotrigine in painful lumbosacral radiculopathy (PLSR). The study did not meet its primary or secondary efficacy endpoints and we discontinued development in PLSR. As a result, we recognized an impairment charge of approximately $60.0 million during the third quarter of 2018 to reduce the fair value of the related IPR&D intangible asset to zero. In addition, we delayed the initiation of the Phase 3 studies of vixotrigine in trigeminal neuralgia (TGN) as we await the outcome of ongoing interactions with the U.S. Food and Drug Administration regarding the design of the Phase 3 studies, a more detailed review of the data from the Phase 2b study of vixotrigine in PLSR, and insights from the Phase 2 study of vixotrigine in small fiber neuropathy. We reassessed the fair value of the TGN program using reduced expected lifetime revenues, higher expected clinical development costs, and a lower cumulative probability of success, and as a result of that assessment, we recognized an impairment charge of $129.3 million during the third quarter of 2018 to reduce the fair value of the TGN IPR&D intangible asset to $41.8 million.

[C] (Gain) loss on fair value remeasurement of contingent consideration for the LTM period reflects the recognition of a $89.6 million gain in the third quarter of 2018 to reflect the lower cumulative probabilities of success related to our TGN program.

[D] In June 2018 we closed a new ten-year exclusive agreement with Ionis Pharmaceuticals, Inc. (Ionis) to develop novel antisense oligonucleotide drug candidates for a broad range of neurological diseases for a total payment of $1.0 billion consisting of an upfront payment of $375.0 million and the purchase of approximately 11.5 million shares of Ionis' common stock at a cost of $625.0 million.

The 11.5 million shares of Ionis' common stock were purchased at a premium to their fair value at the transaction closing date. The premium consisted of acquiring the shares at a price above the fair value based on the trailing 10-day weighted-average close price prior to entering into the agreement in April 2018 and the effect of certain holding period restrictions. We recorded an asset of $462.9 million in investments and other assets in our condensed consolidated balance sheets reflecting the fair value of the common stock and a charge of $162.1 million to research and development expense in our condensed consolidated statements of income during the second quarter of 2018, reflecting the premium paid for the common stock.

[E] In October 2017 we amended the terms of our collaboration and license agreement with Neurimmune SubOne AG (Neurimmune). Under the amended agreement, we made a $150.0 million payment to Neurimmune in exchange for a 15% reduction in royalty rates payable on products developed under this agreement, including on potential commercial sales of aducanumab, our anti-amyloid beta antibody candidate for the treatment of Alzheimer's disease. In May 2018 we made an additional $50.0 million payment to Neurimmune to further reduce the previously negotiated royalty rates payable on products developed under this agreement, including on potential commercial sales of aducanumab, by an additional 5%.

Net distribution to noncontrolling interest for the LTM period reflects the $150.0 million and $50.0 million payments made to Neurimmune, net of Neurimmune's tax, in October 2017 and May 2018, respectively.

Net distribution to noncontrolling interest for the twelve months ended December 31, 2017, reflects the $150.0 million payment made to Neurimmune, net of Neurimmune's tax, in October 2017.

[F] 2017 corporate strategy implementation charges are related to our efforts to create a leaner and simpler operating model.

[G] Restructuring charges for the LTM period and the twelve months ended December 31, 2017, are related to our efforts to create a leaner and simpler operating model in connection with our 2017 corporate strategy.

Restructuring charges for the twelve months ended December 31, 2016, reflect $8.0 million of costs incurred in connection with our 2015 corporate restructuring and charges of $17.7 million incurred in connection with additional cost savings measures primarily intended to realign our organizational structure in anticipation of the changes in roles and workforce resulting from our decision to spin off our hemophilia business and to achieve further targeted cost reductions. Restructuring charges for the twelve months ended December 31, 2016, also include severance charges of $7.4 million related to employee separation costs as a result of our decision to vacate and cease manufacturing in Cambridge, MA and vacate our warehouse in Somerville, MA.

Restructuring charges for the twelve months ended December 31, 2015, reflect $93.4 million of costs incurred in connection with our 2015 corporate restructuring.

[H] Cambridge manufacturing facility rationalization costs for the twelve months ended December 31, 2016, reflect charges to cost of sales, excluding amortization of acquired intangible assets of $45.5 million and $6.9 million for additional depreciation and the write-down of excess inventory, respectively, incurred in connection with our decision to vacate and cease manufacturing in Cambridge, MA and vacate our warehouse in Somerville, MA.

[I] The Tax Cuts and Jobs Act of 2017 (2017 Tax Act), which was signed into law in December 2017, has resulted in significant changes to the U.S. corporate income tax system. During the fourth quarter of 2017 we recognized within our provision for income taxes a $1.2 billion provisional estimate under the U.S. Securities and Exchange Commission Staff Accounting Bulletin No. 118. Our provisional estimate included an amount resulting from a one-time mandatory deemed repatriation tax on accumulated foreign subsidiaries' previously untaxed foreign earnings (the Transition Toll Tax) and amounts related to the impact of remeasuring our deferred tax balances to reflect other aspects of the 2017 Tax Act. The final determination of the Transition Toll Tax and remeasurement of our deferred assets and liabilities will be completed as additional information becomes available, but no later than one year from the enactment of the 2017 Tax Act. Our preliminary estimate of the Transition Toll Tax and the remeasurement of our deferred tax assets and liabilities is subject to the finalization of management's analysis related to certain matters, such as developing interpretations of the provisions of the 2017 Tax Act and changes to certain estimates and amounts related to the earnings and profits of certain subsidiaries.

Tax reform amounts for the LTM period reflects the $1.2 billion provisional estimate recorded in the fourth quarter of 2017 and the effect of a net reduction of $34.6 million in our estimated Transition Toll Tax, an expense of $12.7 million for the remeasurement of our deferred tax balances, and an $11.0 million expense to reflect other aspects of the 2017 Tax Act recognized during the nine months ended September 30, 2018.