

Novartis announces *Lancet* publication of pioneering study in migraine prevention showing efficacy of Aimovig® where other treatments have failed

- *The LIBERTY trial is the first study of a CGRP-targeted therapy in a patient population where multiple preventive treatments had previously failed*
- *Patients treated with Aimovig, reported significant reductions in monthly migraine days and a substantially improved ability to take part in daily activities vs placebo*
- *Tolerability and safety profile of Aimovig was similar to placebo, in line with data seen across the clinical trial program of over 3,000 patients*
- *Aimovig is the first and only FDA and EMA approved CGRP-targeted therapy specifically designed for migraine prevention*

Basel, October 23, 2018 – Novartis announced today that the full data from the LIBERTY study of Aimovig® (erenumab) in episodic migraine patients who had tried and failed two to four prior preventive treatments have been published in *the Lancet*.¹ Patients treated with Aimovig had significant improvements on all primary and secondary endpoints of the study. Aimovig is specifically developed to prevent migraine by blocking the calcitonin gene-related peptide receptor (CGRP-R), which plays a critical role in migraine.

“These findings provide real hope for patients who have been suffering for years with the pain and disability of migraine while cycling through numerous treatment options due to lack of efficacy or intolerable side effects.” said Prof. Uwe Reuter, Managing Medical Director at Charité Universitätsmedizin. “These results show efficacy for Aimovig in the patients with the highest unmet medical need, not only in reducing migraine days but also in allowing them to get back to their daily lives.”

The LIBERTY data show that, compared to placebo, from baseline to the last month of therapy (weeks 9-12):

- The primary endpoint showed that more than twice as many patients on Aimovig had their migraine days cut by 50% or more (30% vs. 14%; odds ratio 2.7, p=0.002)
- Almost three times as many patients on Aimovig had their migraine days cut by 75% or more (12% vs. 4%; odds ratio 3.2, p=0.025, secondary endpoint)
- 6% of patients on Aimovig were completely migraine free (migraine days cut by 100%) vs no patients (0%) on placebo (secondary endpoint)
- Patients on Aimovig experienced a substantial reduction in monthly migraine days (MMD) (1.8 vs 0.2 fewer MMD, p=0.004, secondary endpoint)
- Those in the Aimovig arm reported significant reductions in the number of days per month using acute migraine-specific medication (1.3 reduction vs 0.5 day increase; p<0.001, secondary endpoint)
- Overall, the tolerability and safety profiles for Aimovig were similar to placebo, in keeping with findings throughout the drug’s clinical trial program of over 3,000 patients

“The ground-breaking LIBERTY data reinforce Aimovig as a safe and effective preventive treatment option for patients across the spectrum of migraine, including those who live with particularly difficult-to-treat migraine,” said Danny Bar-Zohar, Global Head of Neuroscience Development at Novartis Pharmaceuticals. “These patients deserve a preventive treatment option which allows them to be there more at home, at work and with friends. With Aimovig, we are paving the way and reimagining care for these migraine patients who have struggled to find effective preventive therapies.”

The patients in LIBERTY, who had tried multiple treatments without success, represent a section of the migraine community which is highly impacted by the disease in all areas of life. Of note, the recent *My Migraine Voice* study showed that patients with multiple prior treatment failures reported the greatest impact on work productivity compared to those who had not previously tried treatments without success.² Moreover, a higher proportion of these patients reported a negative impact on their social and personal life.³ In LIBERTY, in an additional secondary endpoint, patients treated with Aimovig reported a significantly greater improvement on all outcomes including ability to complete everyday activities, such as chores and getting out of bed, compared to placebo (Migraine Physical Function Impact Diary [MPFID] physical impairment scale, 3.5 point difference, $p=0.003$; everyday activities scale, 3.9 point difference, $p<0.001$).

Aimovig is approved in the European Economic Area, the United States (erenumab-aooe), Canada, Australia, Switzerland, the United Arab Emirates and Singapore.

About LIBERTY

LIBERTY (NCT03096834) is a Phase IIIb, multicenter, randomized 12-week, double-blind, placebo-controlled study evaluating the safety and efficacy of erenumab in patients with episodic migraine (defined in the trial as four to 14 migraine days per month at baseline) who have failed two to four prior preventive treatments for migraine.¹ In the study, 246 participants were randomized to receive erenumab 140 mg or placebo during the 12-week double-blind treatment phase. The primary endpoint was the percentage of patients with at least 50% reduction of monthly migraine days from baseline over the last four weeks of the double-blind treatment phase of the study (weeks 9-12). The trial includes an ongoing 156 week open-label extension study.

Secondary endpoints assessed during the same time period included: change from baseline in monthly migraine days, change from baseline in the number of monthly acute migraine-specific medication treatment days, change from baseline in the Migraine Physical Function Impact Diary (MPFID) physical impairment and impact on everyday activities domain scores. The MPFID is a scale developed to measure these two domains. It has been validated in line with US Food and Drug Administration Patient Reported Outcomes Guidance.⁴ Percentages of patients with a 75% response rate and 100% response rate to erenumab, and safety and tolerability were also assessed as secondary endpoints. The most common adverse events observed in LIBERTY were injection site pain (5.9%), back pain (4.2%) and nasopharyngitis (4.2%).

About Aimovig® (erenumab)

Aimovig is the only migraine prevention treatment, approved in both the European Economic Area and the US (erenumab-aooe) which is designed specifically to block the calcitonin gene related peptide receptor (CGRP-R), which plays a critical role in migraine. Aimovig is also approved in Canada, Australia, Switzerland, the UAE and Singapore. Aimovig has been studied in several large, global, randomized, double-blind, placebo-controlled studies to assess its safety and efficacy in migraine prevention. More than 3,000 patients have participated in our overall clinical trial program. This includes 2,600 participants across the four placebo-controlled pivotal Phase II and Phase III clinical studies as well as participants in further studies such as LIBERTY. The most common side effects in the clinical program to

date have been viral upper respiratory tract infection, upper respiratory tract infection, sinusitis, influenza, and back pain.

Novartis and Amgen are co-commercializing Aimovig in the US. Amgen has exclusive commercialization rights to the drug in Japan and Novartis has exclusive rights to commercialize in the rest of the world.

About Migraine

Migraine is a distinct neurological disease.⁵ It involves recurrent attacks of moderate to severe head pain that is typically pulsating, often unilateral and associated with nausea, vomiting and sensitivity to light, sound and odors.⁶ Migraine is associated with personal pain, disability and reduced quality of life, and financial cost to society.⁷ It has a profound and limiting impact on an individual's abilities to carry out everyday tasks and was reported by the World Health Organization to be one of the top 10 causes of years lived with disability for men and women.⁸ It remains under-recognized and under-treated.^{7,9} Existing preventive therapies have been repurposed from other indications and are often associated with poor tolerability and lack of efficacy, with high discontinuation rates among patients.⁹

About Novartis and Amgen Neuroscience Collaboration

In August 2015, Novartis entered into a global collaboration with Amgen to develop and commercialize pioneering treatments in the field of migraine and Alzheimer's disease. The collaboration focuses on investigational Amgen drugs in the migraine field, including Aimovig (approved by the FDA in May 2018 for the preventive treatment of migraine in adults) and AMG 301 (currently in Phase II development). In April 2017, the collaboration was expanded to include co-commercialization of Aimovig in the U.S. For the migraine programs, Amgen retains exclusive commercialization rights in the U.S. (other than for Aimovig as described above) and in Japan, and Novartis has exclusive commercialization rights in Europe, Canada and rest of world. Also, the companies are collaborating in the development and commercialization of a beta-secretase 1 (BACE) inhibitor program in Alzheimer's disease. The oral therapy CNP520 (currently in Phase III for Alzheimer's disease) is the lead molecule and further compounds from both companies' pre-clinical BACE inhibitor programs may be considered as follow-on molecules.

Novartis in Neuroscience

Novartis has a strong ongoing commitment to neuroscience and to bringing innovative treatments to patients suffering from neurological conditions where there is a high unmet need. We are committed to supporting patients and physicians in multiple disease areas, including Multiple Sclerosis (MS), Alzheimer's disease, Parkinson's disease, Epilepsy and Attention Deficit Hyperactivity Disorder, and have a promising pipeline in MS, Alzheimer's disease, migraine, spinal muscular atrophy and specialty neurology (e.g., neuropathic pain).

Disclaimer

This press release contains forward-looking statements within the meaning of the United States Private Securities Litigation Reform Act of 1995. Forward-looking statements can generally be identified by words such as "pioneering," "potential," "can," "will," "ground-breaking," "commitment," "committed," "investigational," "pipeline," "launch," "ongoing," "promising," "hope," "paving the way," or similar terms, or by express or implied discussions regarding potential marketing approvals, new indications or labeling for Aimovig or the other investigational or approved products described in this press release, or regarding potential future revenues from such products or the collaboration with Amgen. You should not place undue reliance on these statements. Such forward-looking statements are based on our current beliefs and expectations regarding future events, and are subject to significant known and unknown risks and uncertainties. Should one or more of these risks or uncertainties materialize, or should underlying assumptions prove incorrect, actual results may vary materially from those set forth in the forward-looking statements. There can be no guarantee

that Aimovig or the other investigational or approved products described in this press release will be submitted or approved for sale or for any additional indications or labeling in any market, or at any particular time. Neither can there be any guarantee that the collaboration with Amgen will achieve any or all of its intended goals and objectives, or be commercially successful. Nor can there be any guarantee that Aimovig or the other investigational or approved products described in this press release will be commercially successful in the future. In particular, our expectations regarding such products and the collaboration with Amgen could be affected by, among other things, the uncertainties inherent in research and development, including clinical trial results and additional analysis of existing clinical data; regulatory actions or delays or government regulation generally; global trends toward health care cost containment, including government, payor and general public pricing and reimbursement pressures; our ability to obtain or maintain proprietary intellectual property protection; the particular prescribing preferences of physicians and patients; general political and economic conditions; safety, quality or manufacturing issues; potential or actual data security and data privacy breaches, or disruptions of our information technology systems, and other risks and factors referred to in Novartis AG's current Form 20-F on file with the US Securities and Exchange Commission. Novartis is providing the information in this press release as of this date and does not undertake any obligation to update any forward-looking statements contained in this press release as a result of new information, future events or otherwise.

About Novartis

Novartis is reimagining medicine to improve and extend people's lives. As a leading global medicines company, we use innovative science and digital technologies to create transformative treatments in areas of great medical need. In our quest to find new medicines, we consistently rank among the world's top companies investing in research and development. Novartis products reach nearly 1 billion people globally and we are finding innovative ways to expand access to our latest treatments. About 125,000 people of more than 140 nationalities work at Novartis around the world. Find out more at www.novartis.com.

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Novartis Media Relations

Central media line: +41 61 324 2200

E-mail: media.relations@novartis.com

Eric Althoff

Novartis Global Media Relations

+41 61 324 7999 (direct)

+41 79 593 4202 (mobile)

eric.althoff@novartis.com

Angela Fiorin

Novartis Global Pharma Communications

+41 61 324 8631 (direct)

+41 79 752 6955 (mobile)

angela.fiorin@novartis.com

Novartis Investor Relations

Central investor relations line: +41 61 324 7944

E-mail: investor.relations@novartis.com

Central

Samir Shah

+41 61 324 7944

Pierre-Michel Bringer

+41 61 324 1065

Thomas Hungerbuehler

+41 61 324 8425

Isabella Zinck

+41 61 324 7188

North America

Richard Pulik

+1 212 830 2448

Cory Twining

+1 212 830 2417