

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): January 29, 2018

**VistaGen Therapeutics, Inc.**

(Exact name of registrant as specified in its charter)

**NEVADA**  
(State or other jurisdiction of incorporation)

**001-37761**  
(Commission File Number)

**20-5093315**  
(IRS Employer Identification Number)

**343 Allerton Ave.**  
**South San Francisco, California 94090**  
(Address of principal executive offices)

**(650) 577-3600**  
(Registrant's telephone number, including area code)

**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 (see General Instruction A.2. below):

- 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))

Indicate by check mark whether the registrant is an emerging growth company as defined in Rule 405 of the Securities Act of 1933 (17 CFR 230.405) or Rule 12b-2 of the Securities Exchange Act of 1934 (17 CFR 240.12b-2)

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act

**Item 7.01**                      **Regulation FD Disclosure**

*Issuance of Letter to Stockholders*

On January 29, 2018, Shawn Singh, Chief Executive Officer and Director of VistaGen Therapeutics, Inc. (the “Company”), sent a letter to the Company’s stockholders highlighting the Company’s recent milestones and discussing the impending launch of the Company’s Phase 2 clinical study of its lead product candidate, AV-101, for the adjunctive treatment of Major Depressive Disorder. A copy of the press release announcing Mr. Singh’s issuance of the letter is attached hereto as Exhibit 99.1, and a copy of Mr. Singh’s letter is attached hereto as Exhibit 99.2.

*Use of New Corporate Presentation*

On January 29, 2018, the Company utilized a new corporate presentation (the “Corporate Presentation”) for business purposes. A copy of the Corporate Presentation is attached hereto as Exhibit 99.3.

The information in this Current Report on Form 8-K, including the information set forth in Exhibits 99.1, 99.2 and 99.3 are being furnished and shall not be deemed “filed” for purposes of Section 18 of the Securities Exchange Act of 1934, as amended (the “Exchange Act”), nor shall any exhibit filed herewith be deemed incorporated by reference in any filing under the Securities Act of 1933, as amended, or the Exchange Act, except as shall be expressly set forth by specific reference in such a filing.

In addition, this Current Report on Form 8-K and the exhibit(s) attached hereto may contain, among other things, certain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, including, without limitation, (i) statements with respect to the Company’s plans, objectives, expectations and intentions; and (ii) other statements identified by words such as “may”, “could”, “would”, “should”, “believes”, “expects”, “anticipates”, “estimates”, “intends”, “plans” or similar expressions. These statements are based upon the current beliefs and expectations of the Company’s management and are subject to significant risks and uncertainties.

**Item 9.01**                      **Financial Statements and Exhibits.**

See Exhibit Index.

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**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 thereunto duly authorized.

**VistaGen Therapeutics, Inc.**

Date: January 30, 2018

By: /s/ Shawn K. Singh  
Shawn K. Singh  
Chief Executive Officer

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EXHIBIT INDEX

<b>Exhibit No.</b>	<b>Description</b>
<a href="#">99.1</a>	Press Release issued by VistaGen Therapeutics, Inc., dated January 29, 2018
<a href="#">99.2</a>	Letter to Shareholders, dated January 29, 2018
<a href="#">99.3</a>	Corporate Presentation, dated January 29, 2018



## VistaGen Therapeutics Issues Letter to Stockholders as Company Prepares to Initiate AV-101 Phase 2 Study for Major Depressive Disorder

South San Francisco, CA (January 29, 2018) – VistaGen Therapeutics, Inc. (NASDAQ: VTGN), a clinical-stage biopharmaceutical company focused on developing new generation medicines for depression and other central nervous system (CNS) disorders, today issued a letter to stockholders as the Company prepares to initiate its Phase 2 study of AV-101 for Major Depressive Disorder (MDD).

The full version of the letter to stockholders may be accessed using the following link, or by visiting the Investor Relations section of the Company's website, [www.vistagen.com](http://www.vistagen.com).

<https://d11io3yog0oux5.cloudfront.net/vistagen/files/docs/shareholder-letter.pdf>

In the letter to stockholders, Shawn Singh, Chief Executive Officer, highlights the Company's recent milestones and discusses the impending launch of the Company's Phase 2 clinical study of AV-101 for MDD. VistaGen's AV-101 is an oral new generation antidepressant with a mechanism of action that is fundamentally differentiated from all standard, FDA-approved antidepressants.

"In early-2017, I had the privilege of "Ring the Bell" at The Nasdaq Stock Market's headquarters in Times Square on behalf of our company. That exciting and unique corporate event proved to be a symbolic prologue to the productive year for VistaGen that followed. The milestones we accomplished in 2017 have strongly positioned us to advance our AV-101 Phase 2 program to new levels throughout this year and next," commented Mr. Singh in the letter to stockholders. "Following a productive meeting with the U.S. Food and Drug Administration (FDA) in the fall of 2017, we achieved two key regulatory milestones before year end. First, in October 2017, the FDA authorized us to proceed, under our Investigational New Drug (IND) application, with our U.S. multi-center Phase 2 clinical study of AV-101 as an oral new generation adjunctive treatment for MDD patients with an inadequate response to standard, FDA-approved antidepressants. In addition, in December 2017, the FDA granted us Fast Track Designation for development of AV-101 for treatment of MDD, providing us the opportunity for frequent FDA interactions regarding the most appropriate and efficient development pathway to bring AV-101 to MDD patients. 2017 culminated with the closing of an underwritten public offering that generated gross proceeds of \$15 million, enabling us to commence and advance through our Phase 2 study in 2018. I want to thank, again, our underwriters and our new and existing investors for supporting our vision."

### Recent Accomplishments:

- Received "green light" from the FDA to launch AV-101 Phase 2 MDD adjunctive treatment study pursuant to our IND.
- Received Fast Track Designation from the FDA for development of AV-101 as an adjunctive treatment for MDD. Fast Track Designation is designed to facilitate the development and review of new treatments for serious conditions, such as MDD, with unmet medical need.
- Continued to strengthen our intellectual property portfolio as the European Patent Office (EPO) granted a patent related to methods of treating depression with AV-101 and certain other neurological indications, and the U.S. Patent and Trademark Office (USPTO) issued [U.S. Patent No. 9,834,801](#) related to certain methods of production for AV-101.
- AV-101 was featured on the cover of *The Journal of Pain* in October 2017, a peer-reviewed publication of nonclinical studies of the effects of AV-101 in well-established nonclinical models of pain. This article is available at the following link: <http://dx.doi.org/10.1016/j.jpain.2017.03.014>.
- Closed underwritten public offering that generated gross proceeds of \$15 million. Proceeds from the offering enable us to continue research and development, primarily related to our Phase 2 clinical study of AV-101 for MDD.

Mr. Singh continued, “As a result of receiving a “green light” from the FDA, we anticipate launching our AV-101 Phase 2 MDD adjunctive treatment study during the current quarter, with topline data expected to be available during the first half of 2019. In addition, we expect one of our principal collaborators, the U.S. National Institute of Mental Health, to complete its Phase 2 monotherapy study of AV-101 in treatment-resistant MDD patients during 2018. This Phase 2 study is being conducted by Dr. Carlos Zarate Jr., Chief, Section on the Neurobiology and Treatment of Mood Disorders and Chief of the Experimental Therapeutics and Pathophysiology Branch at the NIMH. AV-101 caught the attention of Dr. Zarate, widely considered a pioneer in ketamine research for MDD, and his team after head-to-head preclinical studies of AV-101 vs. ketamine, ultimately resulting in a Cooperative Research and Development Agreement between VistaGen and the U.S. National Institutes of Health, whereby the NIMH is fully funding and conducting the NIMH Phase 2 monotherapy MDD study of AV-101.”

**Anticipated Milestones over next 12 to 18 Months:**

- **First Quarter of 2018:**
  - Launch our Phase 2 clinical study of AV-101 for MDD with Dr. Maurizio Fava of Harvard University as Principal Investigator; a 180-patient, U.S. multi-center, double-blind, placebo controlled efficacy and safety study evaluating AV-101 as an adjunctive treatment in MDD patients with an inadequate response to standard, FDA-approved antidepressants.
- **Second Half of 2018:**
  - NIMH AV-101 Phase 2 MDD monotherapy study topline results.
  - Completion of our AV-101 Phase 2 MDD adjunctive treatment study.
- **First Half of 2019:**
  - Launch of AV-101 Phase 2 studies in neuropathic pain and Parkinson’s disease levodopa-induced dyskinesia.
  - AV-101 Phase 2 MDD adjunctive treatment study topline results.

VistaGen kicked off 2018 by hosting meetings with current investors, prospective institutional investors and potential strategic partners during the 36th Annual J.P. Morgan Healthcare Conference and 10<sup>th</sup> Annual Biotech Showcase in San Francisco. Additionally, Mr. Singh participated on a panel with distinguished scientists and clinicians focused on the neuroscience of depression and addiction during the Healthcare Innovation Forum held at the University of California, San Francisco (UCSF) Medical Center in San Francisco.

Mr. Singh concluded, “Reflecting on a productive week in San Francisco, it is apparent to us that a paradigm shift towards a new generation of faster-acting antidepressants, particularly those targeting NMDA and AMPA receptors, is emerging. Throughout 2018, we will remain focused on our core mission - to develop new generation medicines for depression and other CNS disorders affecting millions of people worldwide who do not currently have adequate treatment alternatives. Personally, and professionally, I am motivated and passionate about our mission. I maintain the highest confidence in our strategy and our team, and I anticipate that 2018 will yield even more exciting achievements intended to deliver both life-changing benefits to CNS patients and extraordinary value to our stockholders.”

## **About VistaGen**

VistaGen Therapeutics, Inc. (NASDAQ: VTGN), is a clinical-stage biopharmaceutical company focused on developing new generation medicines for depression and other CNS disorders. VistaGen's lead CNS product candidate, AV-101, is in Phase 2 development, initially as a new generation oral antidepressant drug candidate for MDD. AV-101's mechanism of action is fundamentally different from all FDA-approved antidepressants and atypical antipsychotics used adjunctively to treat MDD, with potential to drive a paradigm shift towards a new generation of safer and faster-acting antidepressants. AV-101 is currently being evaluated by the U.S. National Institute of Mental Health (NIMH) in a small Phase 2 monotherapy study in MDD being fully funded by the NIMH and conducted by Dr. Carlos Zarate Jr., Chief, Section on the Neurobiology and Treatment of Mood Disorders and Chief of Experimental Therapeutics and Pathophysiology Branch at the NIMH. VistaGen is preparing to launch a 180-patient Phase 2 study of AV-101 as an adjunctive treatment for MDD patients with an inadequate response to standard, FDA-approved antidepressants. Dr. Maurizio Fava of Harvard University is the Principal Investigator of the VistaGen's AV-101 MDD Phase 2 adjunctive treatment study. AV-101 may also have the potential to treat multiple CNS disorders and neurodegenerative diseases in addition to MDD, including neuropathic pain, epilepsy, Huntington's disease, Parkinson's disease levodopa-induced dyskinesia (PD LID) and other CNS diseases and disorders where modulation of the NMDA receptors, activation of AMPA pathways and/or key active metabolites of AV-101 may achieve therapeutic benefit.

For more information, please visit [www.vistagen.com](http://www.vistagen.com) and connect with VistaGen on:

[Twitter](#)

[LinkedIn](#)

[Facebook](#)

## **Forward-Looking Statements**

The statements in this press release that are not historical facts may constitute forward-looking statements that are based on current expectations and are subject to risks and uncertainties that could cause actual future results to differ materially from those expressed or implied by such statements. Those risks and uncertainties include, but are not limited to, risks related to the successful launch, continuation and results of the NIMH's Phase 2 (MDD monotherapy) and/or the Company's planned Phase 2 (MDD adjunctive treatment) clinical studies of AV-101, allowance of patent applications and continued protection of its intellectual property, and the availability of substantial additional capital to support its operations, including the AV-101 Phase 2 clinical development activities described above. These and other risks and uncertainties are identified and described in more detail in VistaGen's filings with the Securities and Exchange Commission (SEC). These filings are available on the SEC's website at [www.sec.gov](http://www.sec.gov). VistaGen undertakes no obligation to publicly update or revise any forward-looking statements.

## **Company Contact**

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January 29, 2018

Dear Fellow Stockholders:

In early-2017, I had the privilege of “Ring the Bell” at The Nasdaq Stock Market’s headquarters in Times Square on behalf of our company. That exciting and unique corporate event proved to be a symbolic prologue to the productive year for VistaGen that followed. The milestones we accomplished in 2017 have strongly positioned us to advance our AV-101 Phase 2 program to new levels throughout this year and next.

### **Regulatory and Clinical Development**

We refer to AV-101 as a “new generation” antidepressant because its mechanism of action (the way it works in the brain) is fundamentally different from all FDA-approved antidepressants, as well as all FDA-approved atypical antipsychotics often used together with standard antidepressants. Investment, innovation, industry expertise and a lot of hard work by our focused and passionate teams, teams committed to making a game-changing impact in the treatment of multiple diseases and disorders involving the central nervous system (CNS), have advanced us to the threshold of launching our potentially transformative Phase 2 study of AV-101 for treatment of Major Depressive Disorder (MDD). Our primary goal is to develop and ultimately receive regulatory approval to commercialize AV-101 worldwide for multiple CNS diseases and disorders. Our initial regulatory and commercial strategies to accomplish that goal are focused on developing AV-101 as an oral, safe, and faster-acting new generation treatment alternative for millions of MDD patients with inadequate therapeutic results from standard antidepressants, displacing atypical antipsychotics in the current MDD drug treatment paradigm. It is a potentially game-changing goal indeed, and our teams are well-suited for the challenge.

Following a productive meeting with the U.S. Food and Drug Administration (FDA) in the Fall of 2017, we achieved two key regulatory milestones before year end. First, in October 2017, the FDA authorized us to proceed, under our Investigational New Drug (IND) application, with our U.S. multi-center Phase 2 clinical study of AV-101 as an oral new generation adjunctive treatment for MDD. This study will focus on treatment of MDD patients with an inadequate response to standard, FDA-approved antidepressants. In addition, in December 2017, the FDA granted us Fast Track Designation for development of AV-101 for treatment of MDD, providing us the opportunity for frequent FDA interactions regarding the most appropriate and efficient development pathway to bring AV-101 to MDD patients.

As a result of receiving a “green light” from the FDA, we anticipate launching our AV-101 Phase 2 MDD adjunctive treatment study during the current quarter, with topline data expected to be available during the first half of 2019.

During 2018, we expect one of our principal collaborators, the U.S. National Institute of Mental Health (NIMH), to complete its Phase 2 monotherapy study of AV-101 in treatment-resistant MDD patients. This Phase 2 study is being conducted by Dr. Carlos Zarate Jr., Chief, Section on the Neurobiology and Treatment of Mood Disorders and Chief of the Experimental Therapeutics and Pathophysiology Branch at the NIMH. AV-101 caught the attention of Dr. Zarate, widely considered a pioneer in ketamine research for MDD, and his team after head-to-head preclinical studies of AV-101 vs. ketamine, ultimately resulting in a Cooperative Research and Development Agreement (CRADA) between VistaGen and the U.S. National Institutes of Health (NIH), whereby the NIMH is fully funding and conducting the NIMH Phase 2 monotherapy MDD study of AV-101.



## **Manufacturing and Patents**

In connection with our AV-101 Phase 2 program, as well as potential Phase 3 development and commercialization, we, together with our contract manufacturing organization, developed a novel process for the production of AV-101 drug substance. We believe our new proprietary AV-101 production process will significantly improve manufacturing efficiency.

We strengthened our intellectual property around AV-101 in 2017. In Europe, the European Patent Office (EPO) granted our patent related to methods of treating depression with AV-101 and certain other neurological indications. Additionally, the U.S. Patent and Trademark Office (USPTO) granted a patent related to certain methods of production of AV-101. These issued patents, together with the potential issuance of additional AV-101 patent applications currently under review in the US, European Union and other key pharmaceutical markets, provide VistaGen with added long-term intellectual property protection for AV-101 and enhance its commercial potential.

## **Additional Highlights**

### *AV-101 for Neuropathic Pain and Parkinson's Disease Levodopa-induced Dyskinesia (PD LID)*

In addition to MDD, we believe AV-101 may also have the potential to treat multiple CNS disorders and neurodegenerative diseases, including neuropathic pain, PD LID and other CNS diseases and disorders where modulation of NMDA receptors, activation of AMPA pathways and/or key active metabolites of AV-101 may achieve therapeutic benefit. In October 2017, a peer-reviewed publication of nonclinical studies of the effects of AV-101 in four well-established nonclinical models of pain was featured on the cover of *The Journal of Pain* (<http://dx.doi.org/10.1016/j.jpain.2017.03.014>). In these studies, AV-101 was found to have robust anti-nociceptive effects, similar to gabapentin, but with a better side effect profile in several pre-clinical models of hyperalgesia and allodynia, with results suggesting AV-101's potential for treating multiple pain states. We believe the positive results published in these studies, taken together with successful AV-101 Phase 1a and 1b clinical safety studies and the epidemic abuse of prescription opioid pain medicines, support further investment in Phase 2 clinical studies to assess efficacy and safety of AV-101 as a new non-opioid treatment alternative for patients suffering from neuropathic pain. We are also excited about the opportunity to explore AV-101's potential to reduce dyskinesia associated standard levodopa, or L-DOPA, therapy for Parkinson's disease, based on results from non-clinical studies. Without diverting our priority focus on MDD, we plan to expand our AV-101 Phase 2 clinical program during the next year to include these important CNS indications with significant unmet need.

### *Capital Markets*

2017 culminated with the closing of an underwritten public offering that generated gross proceeds of \$15 million. This financing enables us to commence and advance our Phase 2 study in 2018. I want to thank, again, our underwriters and our new and existing investors for supporting our vision.

Earlier this month, our team kicked off 2018 by hosting numerous meetings with current investors, prospective institutional investors and potential strategic partners during the 36th Annual J.P. Morgan Healthcare Conference and 10<sup>th</sup> Annual Biotech Showcase in San Francisco. Additionally, I was honored to participate on a panel with distinguished scientists and clinicians focused on the neuroscience of depression and addiction during the Healthcare Innovation Forum held at the University of California, San Francisco (UCSF) Medical Center in San Francisco. Our in-depth panel discussions were not only encouraging and motivating, but also eye-opening regarding potential advances in neuropsychiatry on the horizon at UCSF.

Reflecting on a productive week in San Francisco, it is apparent that a paradigm shift towards a new generation of faster-acting antidepressants, particularly those targeting NMDA and AMPA receptors, is emerging. The positive effects on depression and pain through the IV administration of ketamine is well documented, and significant investment has been made by big Pharma to explore its benefits. For example, Janssen Research & Development, one of the Janssen Pharmaceutical Companies of Johnson & Johnson, has made a significant investment in esketamine, an intranasally-administered NMDA receptor antagonist currently in Phase 3 development with a mechanism of action similar to ketamine treatment currently administered by injection. If approved by the FDA, esketamine would be one of the first new approaches to treat patients with MDD in the last 50 years. Similar to ketamine and esketamine, AV-101 targets the NMDA and AMPA receptors, however AV-101 is oral and it inhibits the NMDA receptor activity rather than blocking it, thereby producing ketamine-like antidepressant effects without safety concerns associated with ketamine.

I am as eager and passionate as I have ever been to see what transpires from our AV-101 Phase 2 program, especially our impending Phase 2 adjunctive treatment study in MDD patients with an inadequate response to standard antidepressants. Throughout 2018, we will remain focused on our core mission - to develop new generation medicines for depression and other CNS disorders affecting millions of people worldwide who do not currently have adequate treatment alternatives. I maintain the highest confidence in our strategy and our teams, and I anticipate that 2018 will yield even more exciting achievements intended to deliver both life-changing benefits to CNS patients and extraordinary value to our stockholders.

Very truly yours,



Shawn Singh,  
Chief Executive Officer and Director  
VistaGen Therapeutics, Inc.




VistaGen®  
Therapeutics

Corporate Presentation

NobleCon14

January 29, 2018

[www.vistagen.com](http://www.vistagen.com)

 Nasdaq: VTGN

DEVELOPING NEW GENERATION MEDICINES FOR DEPRESSION AND OTHER CNS DISORDERS

## Forward-looking Statements



This presentation contains “forward-looking statements” within the meaning of the Private Securities Litigation Reform Act of 1995. These forward-looking statements concern our product candidates, our development efforts, our collaborations, our intellectual property, our financial condition, our plans and our development programs. These statements involve risks, uncertainties and assumptions, and are based on the current estimates and assumptions of the management of VistaGen Therapeutics, Inc. (Company) as of the date of this presentation and are subject to uncertainty and changes. Given these uncertainties, you should not place undue reliance on these forward-looking statements.

Important factors that could cause actual results to differ materially from those indicated by such forward-looking statements include, among others, those set forth in our Annual Report on Form 10-K for the year ended March 31, 2017, filed with the Securities and Exchange Commission (SEC) on June 29, 2017, as well as any updates to those risk factors filed with the SEC from time to time in our periodic and current reports on Forms 8-K and 10-Q. All statements contained in this presentation are made only as of the date of this presentation, and the Company undertakes no duty to update this information unless required by law.

# VistaGen Overview

NASDAQ: VTGN



Clinical-stage, CNS-focused, emphasis on depression, pain and Parkinson's disease levodopa-induced dyskinesia (PD LID)



Potentially transformative clinical catalysts in 2018 and 2019



AV-101, oral new generation antidepressant; new non-opioid alternative for neuropathic pain



Strong long term support from NIH



Phase 2 in depression ongoing in 2018; Phase 2 in pain and PD LID in 2019



Experienced teams leading execution

# Major Depressive Disorder (MDD)

SUBSTANTIAL MARKET WITH GROWING UNMET NEED

OVER  
**300 MILLION**  
PEOPLE WORLDWIDE SUFFER  
FROM DEPRESSION<sup>1</sup>



1 in 10 in U.S. Over Age 12  
Takes an Antidepressant<sup>2</sup>



Global Depression Market is  
Expected to Grow<sup>3</sup>



U.S. Drug-Treated  
MDD Market is  
Substantially  
Underserved<sup>4,5</sup>

**11.6M**  
U.S. Drug-Treated  
Patients with MDD

**7.3M**  
U.S. Patients with  
Inadequate Response  
to Initial MDD Therapy  
63% Treated with 2<sup>nd</sup> Line  
Therapy

**5.1M**  
U.S. Patients with  
Inadequate Response to  
MDD Therapy  
44% Treatment-Resistant  
after 2<sup>nd</sup> Line Therapy

## INITIAL AV-101 TARGET MARKET

1: World Health Organization; 2: U.S. National Institutes of Mental Health; 3: Zion Research: Depression Drug Market: April 2016; 4: Rush AJ, et al. Am J Psychiatry. 2006; 163(11): 1905-1917 (STAR\*D Study); 5: Decision Resources 2016



## Current FDA-Approved Drug Treatments for MDD

PROBLEMS WITH CURRENT ANTIDEPRESSANTS AND ADJUNCTIVE ATYPICAL ANTIPSYCHOTICS



**PROZAC**  
fluoxetine hydrochloride



**Zoloft**  
(sertraline HCl)



**Cymbalta**  
duloxetine HCl



**ABILIFY**  
(aripiprazole)



**REXULTI**  
brexpiprazole  
tablets



**Seroquel**  
quetiapine fumarate

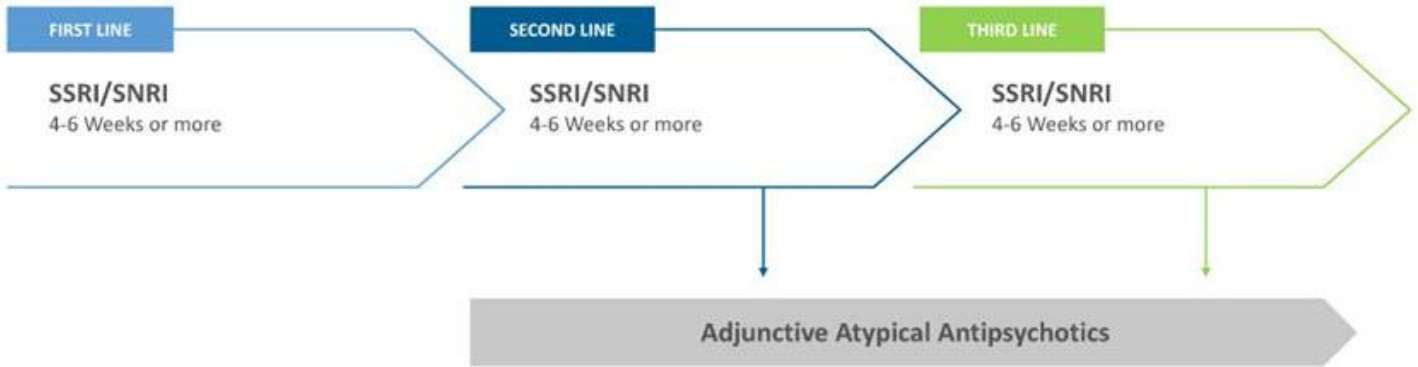
### Current Antidepressants

- **Often do not work**
  - Initial treatment effective in only 1 of 3 patients
- **Slow to work**
  - May take 4 to 6 weeks or more to achieve antidepressant effects
- **Side-effects**
  - Anxiety, decreased libido, nausea, sleep, disturbances, weight gain and more

### Current Adjunctive Atypical Antipsychotics

- **Limited efficacy**
  - Only 10 to 20% of MDD patients respond
- **Side effects**
  - Weight gain, metabolic syndrome, tardive dyskinesia, sedation, cognitive impairment
- **Safety concerns**
  - “Black Box” warnings - mortality in elderly, cardiovascular complications, convulsions, stroke

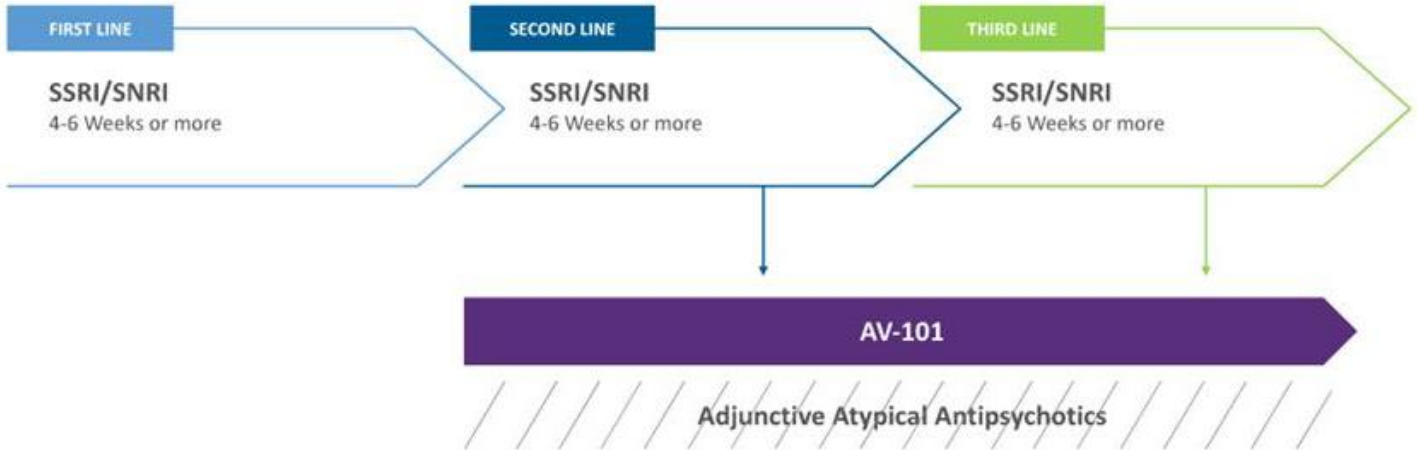
## Current MDD Drug Treatment Paradigm





# Initial Target in Current MDD Drug Treatment Paradigm

AV-101'S INITIAL FIT, AS A NEW GENERATION ADJUNCTIVE THERAPY



Initial Objective - Displace Adjunctive Atypical Antipsychotics in the MDD Drug Treatment Paradigm

## Ketamine is Driving a Paradigm Shift in the Treatment of MDD



“Recent data suggest that ketamine, given intravenously, might be the most important breakthrough in antidepressant treatment in decades.”

**Thomas Insel**

*Former Director - U.S. National Institute of Mental Health<sup>1</sup>*

1: <http://www.nimh.nih.gov/about/director/2014/ketamine.shtml>

# The Ketamine Story

A PARADIGM SHIFT TOWARDS NEW GENERATION ANTIDEPRESSANTS



FDA-approved  
anesthetic



Currently, only  
available by injection



Popular Club Drug:  
"Special K"

**NUMEROUS SAFETY CONCERNS:** confusion, dissociation, hallucinations, dizziness, increased blood pressure and heart rate, abuse potential

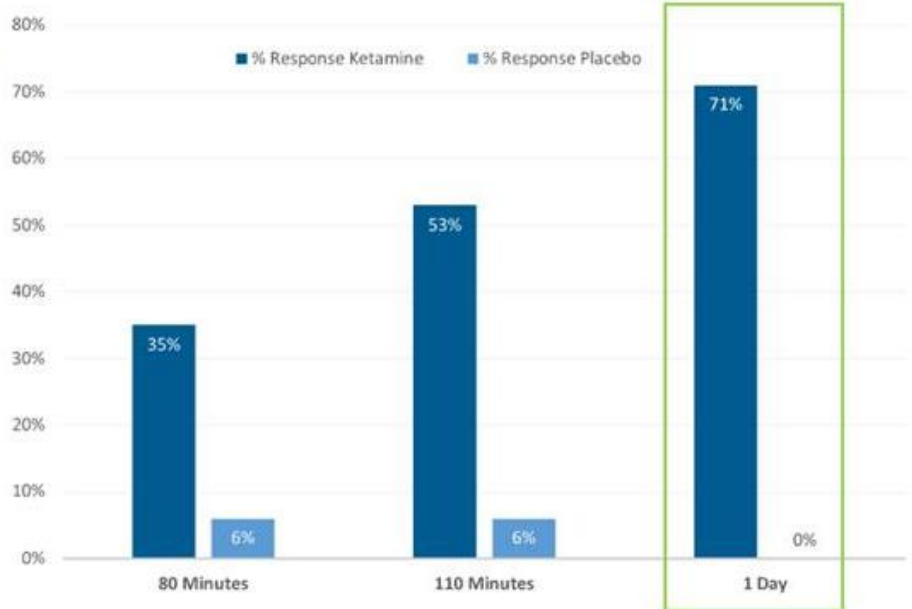
- MOA is fundamentally different from all FDA-approved antidepressants and adjunctive atypical antipsychotics
- Clinical studies at the NIMH and academic research centers in treatment-resistant MDD patients had game-changing results

# NIMH's Breakthrough Ketamine Study in Treatment-resistant MDD

ANTIDEPRESSANT EFFECTS WITHIN 1 DAY OF A SINGLE TREATMENT

## Responder<sup>‡</sup> Rates at 1 Day with Ketamine in Treatment-resistant MDD

<sup>‡</sup> Proportion of patients with treatment-resistant MDD with at least 50% improvement in depression rating



<sup>‡</sup>Zarate, C. A., Jr., et al. (2006) "A randomized trial of an N-methyl-D-aspartate antagonist in treatment-resistant major depression." *Arch Gen Psychiatry* 63:856-864.

Also see:

- Murrough, J. W., et al. (2013) "Antidepressant efficacy of ketamine in treatment-resistant major depression: a two-site randomized controlled trial." *Am J Psychiatry* 170:1134-1142.
- Zarate, C. A., Jr., et al. (2012) "Replication of ketamine's antidepressant efficacy in bipolar depression: a randomized controlled add-on trial." *Biol Psychiatry* 71:939-946.

## Ketamine offers new hope for MDD patients, but is it a long-term solution?

“Club Drug Ketamine **Provides Hope** in Fight Against Depression”

**TIME**

“Drugs to Lift Depression **in Hours** Rather Than Weeks”

**THE WALL STREET JOURNAL**

## AV-101 (4-Chlorokynurenine)

POTENTIAL KETAMINE-LIKE NEW GENERATION TREATMENT FOR MDD



### ORAL

- 📍 Prodrug, rapidly absorbed through the gut, actively transported into the brain, converted into its active metabolite, which binds to NMDA receptors

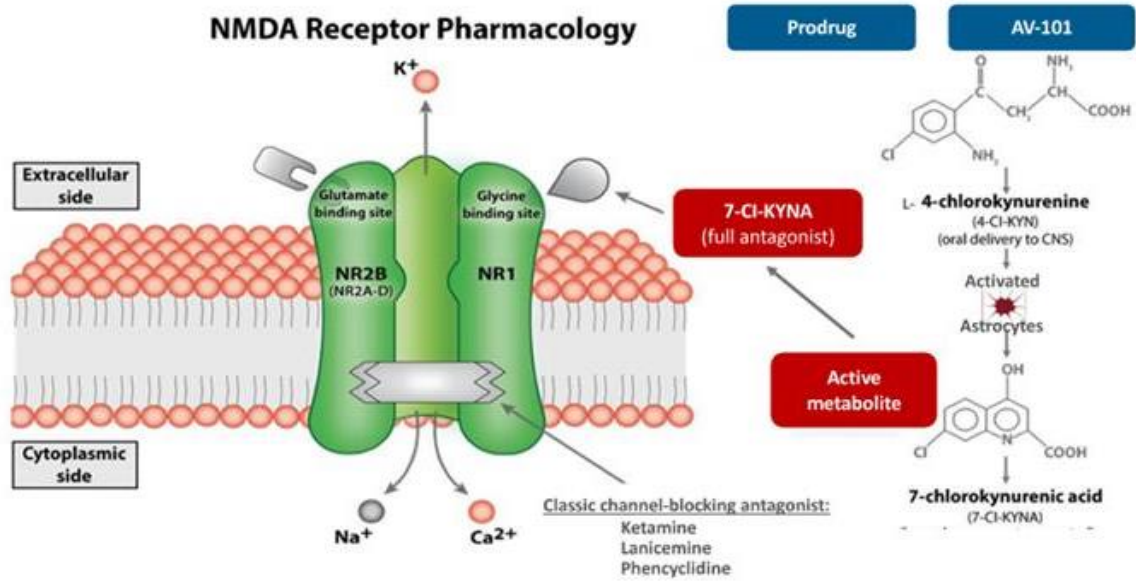
### FAST-ACTING, KETAMINE-LIKE ANTIDEPRESSANT EFFECTS, WITHOUT KETAMINE'S SAFETY CONCERNS

- 📍 Inhibits NMDAR activity through Gly<sub>B</sub> site binding; ketamine blocks the ion channel of NMDAR and induces psychotomimetic side effects
- 📍 Like ketamine, AV-101 demonstrates fast-acting antidepressant effects in rodent models via upregulation of AMPA receptors
- 📍 Well-tolerated in two NIH-funded Phase 1 safety studies
- 📍 Currently in Phase 2 clinical development
- 📍 Drug-drug interaction and "Black Box" metabolic effects not anticipated



# AV-101's Mechanism of Action

AV-101'S ACTIVE METABOLITE (7-Cl-KYNA) INHIBITS NMDA RECEPTOR ACTIVITY



# AV-101 vs. Ketamine

PRECLINICAL EVIDENCE OF KETAMINE-LIKE ANTIDEPRESSANT EFFECTS WITHOUT KETAMINE-LIKE SAFETY CONCERNS



The Journal of Pharmacology and Experimental Therapeutics

## “The Prodrug 4-Chlorokynurenine Causes Ketamine-Like Antidepressant Effects, but Not Side Effects, by NMDA/Glycine<sub>B</sub>-Site Inhibition”

Panos Zanos, Sean C. Piantadosi, Hui-Qiu Wu, Heather J. Pribut, Matthew J. Dell, Adem Can, H. Ralph Snodgrass, Carlos A. Zarate, Jr., Robert Schwarcz, and Todd D. Gould



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### The Prodrug 4-Chlorokynurenine Causes Ketamine-Like Antidepressant Effects, but Not Side Effects, by NMDA/Glycine<sub>B</sub>-Site Inhibition<sup>1</sup>

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**ABSTRACT**  
Currently approved antidepressant drug treatment typically takes several weeks to be effective. The noncompetitive N-methyl-D-aspartate (NMDA) receptor antagonist ketamine has shown efficacy as a rapid-acting treatment of depression, but its use is associated with significant side effects. We assessed effects following blockade of the glycine co-agonist site of the NMDA receptor, located on the GluN1 subunit, by the selective full antagonist 7-chlorokynurenic acid (7-Cl-KYN), delivered by systemic administration of its brain-permeant prodrug 4-chlorokynurenine (4-Cl-KYN) *in vivo*. Following administration of 4-Cl-KYN, 7-Cl-KYN was promptly recovered extracellularly in hippocampal interstitial fluid shortly after dosing. The behavioral responses of the animals were assessed using measures of ketamine-sensitive antidepressant efficacy (including the 24-hour forced swim test, learned helplessness test, and novelty-suppressed feeding test) in these tests distinct from ketamine, and similar to ketamine, 4-Cl-KYN administration resulted in rapid, dose-dependent and persistent antidepressant-like effects following a single treatment. The antidepressant effects of 4-Cl-KYN were prevented by pretreatment with glycine or the acutely-acting NMDA receptor antagonist 2,3-dihydroxy-6-nitro-7-sulfamoylquinoline (NBQX). 4-Cl-KYN administration was not associated with the rewarding and psychotomimetic effects of ketamine, and did not induce locomotor stimulation or stereotypic behaviors. Our results provide further support for antagonism of the glycine site for the rapid treatment of treatment-resistant depression without the negative side effects seen with ketamine or other channel-blocking NMDA receptor antagonists.

**Introduction**  
Although interventions for major depressive disorder (MDD) such as pharmacotherapies and cognitive behavioral psychotherapies are available, more than 30% of patients require treatment respite. Even when effective, currently used antidepressant drugs often take up to several months to exert their full therapeutic effects (Gould et al., 2006). Moreover, compelling evidence suggests a key role for the glutamatergic system in mood disorders (Pezawas et al., 2012). These glutamate levels are higher in the brains of depressed patients compared with healthy individuals (Sanacora et al., 2012), and evidence indicates that the N-methyl-D-aspartate (NMDA) subtype of glutamate receptors can be successfully targeted for the treatment of MDD (Vostanis et al., 2007). Fluoxetine-treated rats have demonstrated rapid-acting antidepressant effects, within hours, of subcutaneous doses of the noncompetitive NMDA receptor antagonist ketamine in treatment-resistant depressed patients (Lee Duman (2014)). Moreover, antidepressant effects of ketamine have been demonstrated in several rodent tests in experimental animals (Zhu and Lucki (2015)). However, ketamine's potential as a long-term antidepressant medication is limited by its additive properties and its anesthetic, cognitive, and psychotomimetic side effects (Zhu et al., 2014).

**ABBREVIATIONS:** 4-Cl-KYN, 4-chlorokynurenine; 7-Cl-KYN, 7-chlorokynurenic acid; NBQX, 2,3-dihydroxy-6-nitro-7-sulfamoylquinoline; NMDA, N-methyl-D-aspartate; AV-101, 4-chlorokynurenine; FIA, fluorescence; FST, forced swim test; GYK 53655, (S)-1-(2,3-dihydroxy-5-propyl-1-methylpyrrolidin-5-yl)-1-(2S,5S)-2-pyrrolidinecarboxylic acid; ketamine, (S)-2-(2,6-dimethyltetrahydro-2H-pyridin-3-yl)-N,N-dimethylpropan-1-amine; MDD, major depressive disorder; MBZM, (S)-1-(2,3-dihydroxy-6-nitro-7-sulfamoylquinolin-2-yl)-2,3-dihydroquinoline; NBQX, 2,3-dihydroxy-6-nitro-7-sulfamoylquinoline; NMDA, N-methyl-D-aspartate; NSF, novelty-suppressed feeding test; TST, tail suspension test.

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## AV-101 vs. Ketamine in Published Preclinical Studies

Benefits	AV-101	Ketamine
Forced-swim	EQUIVALENT	
Tail-suspension	EQUIVALENT	
Learned-helplessness	EQUIVALENT	
Novelty-suppressed feeding	EQUIVALENT	

Negative Behavioral Effects	AV-101	Ketamine
Abusive potential	No	Yes
Hyper movement	No	Yes
Movement sensitization	No	Yes
Circling and rearing	No	Yes
Sensory-motor gating	No	Yes

Zanos, P., et al. (2015). "The Prodrug 4-Chlorokynurenine Causes Ketamine-Like Antidepressant Effects, but Not Side Effects, by NMDA/GlycineB-Site Inhibition." *J Pharmacol Exp Ther* 355(1): 76-85.

## NIH Support for AV-101

VALUABLE LONG-TERM RELATIONSHIP AND SUPPORT FOR AV-101 DEVELOPMENT

### Direct funding for AV-101 Preclinical and Phase 1

\$8.8 million in direct non-dilutive cash awards for support of AV-101 preclinical development and first-in-human Phase 1 clinical safety studies

### Clinical and financial support for AV-101 Phase 2

Fully funding, and Dr. Carlos Zarate, Jr. as Principal Investigator is conducting, a small (n~20) Phase 2 MDD monotherapy clinical study in treatment-resistant MDD patients



National Institute  
of Mental Health



NIH and Dr. Zarate continue to drive the paradigm shift to new generation antidepressants

## NIH-Sponsored AV-101 Phase 1 Safety Studies

### NO KETAMINE-LIKE SAFETY CONCERNS

#### AV-101 Phase 1a Study

- Randomized, double-blind, placebo-controlled
- Single oral dose with sequential dose-escalation
- Six single dose levels: 30, 120, 360, 720, 1,080, 1,440 mg
- 36 subjects: 18 treatment and 18 placebo; 6 per cohort

#### RESULTS

- Well-tolerated, even at maximum dose; good bioavailability; no serious adverse events
- At higher doses, some subjects on AV-101 (none on placebo) reported positive feelings of well-being similar to antidepressant effects reported with ketamine, without ketamine's side-effects

#### AV-101 Phase 1b Study

- Randomized, double-blind, placebo-controlled
- Multiple oral dose (daily/14 days), sequential dose-escalation
- Three dose levels: 360, 1,080 and 1,440 mg
- 48 subjects: 36 treatment and 12 placebo; 16 per cohort

#### RESULTS

- Well-tolerated, even at maximum dose; good bioavailability; no serious adverse events
- Multiple subjects on AV-101 (none on placebo) reported positive feelings of well-being similar to antidepressant effects reported with ketamine, without ketamine's side-effects

# NIMH-Sponsored AV-101 Phase 2 Monotherapy Study

MDD ORAL MONOTHERAPY

## Principal Investigator:

Dr. Carlos Zarate, Jr., NIMH

- Single site: NIMH
- Double-blind, placebo-controlled, crossover design
- Single oral dose monotherapy, in treatment-resistant MDD patients, once per day for 14 days
- Target enrollment: ca. 20 adult subjects

**Primary Endpoint:**  
Safety and efficacy using standard Hamilton Rating Scale (HRS)

**Secondary Endpoints:**  
Change from baseline in other widely-accepted measures of mood, depression and cognition



NIMH completion expected

## AV-101 Phase 2 Adjunctive Treatment Study

NEW GENERATION ORAL ADJUNCTIVE TREATMENT FOR INADEQUATE SSRI/SNRI MONOTHERAPY

### Principal Investigator:

Dr. Maurizio Fava, Harvard University

- Projected enrollment: ~180 patients
- Double-blind, placebo-controlled, 2-Stage Sequential Parallel Comparison Design (SPCD)
- **Objective:** assess efficacy and safety of AV-101 + standard antidepressants in MDD patients with an inadequate response to standard antidepressants
- Single oral dose, once per day for 14 days
- Projected launch and completion in 2018

#### Primary Endpoint:

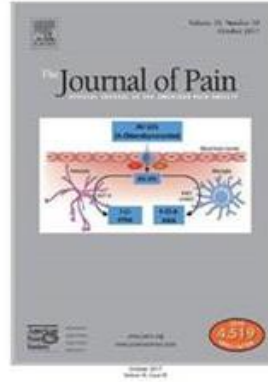
Efficacy demonstrated by a decrease on the Montgomery-Asberg Depression Rating Scale

#### Secondary Endpoints:

Additional widely-accepted measures of mood, depression and cognition



# AV-101 for Neuropathic Pain



## UNMET MEDICAL NEED

At least 5% of U.S. population suffers from severe neuropathic pain; most treated with addictive opioids or marginally effective antidepressants and anticonvulsants

## RATIONALE

NMDA receptor antagonists such as ketamine can improve neuropathic pain, but their risk/benefit ratio is too problematic to permit chronic, widespread use

## EVIDENCE FOR AV-101

In recently published preclinical studies, AV-101 reduced neuropathic pain in four well-established models of pain with similar efficacy to gabapentin, but with a superior side effect profile<sup>1</sup>

## NEXT STEP

**Phase 2 study of AV-101 vs placebo in patients with neuropathic pain**

1. Yaksh, T.L., et al. (2017). "Characterization of the Effects of L-4-Chlorokynurenine on Nociception in Rodents." *The Journal of Pain* 18: 1184-1196.

## AV-101 for Parkinson's disease levodopa-induced dyskinesia

### UNMET MEDICAL NEED

Levodopa is the most effective treatment for Parkinson's disease (PD), but chronic levodopa therapy causes PD levodopa-induced dyskinesia (LID) in a significant number of cases

### RATIONALE

Weak NMDA antagonists, such as amantadine, are approved for PD LID, but have significant side effects

### EVIDENCE FOR AV-101

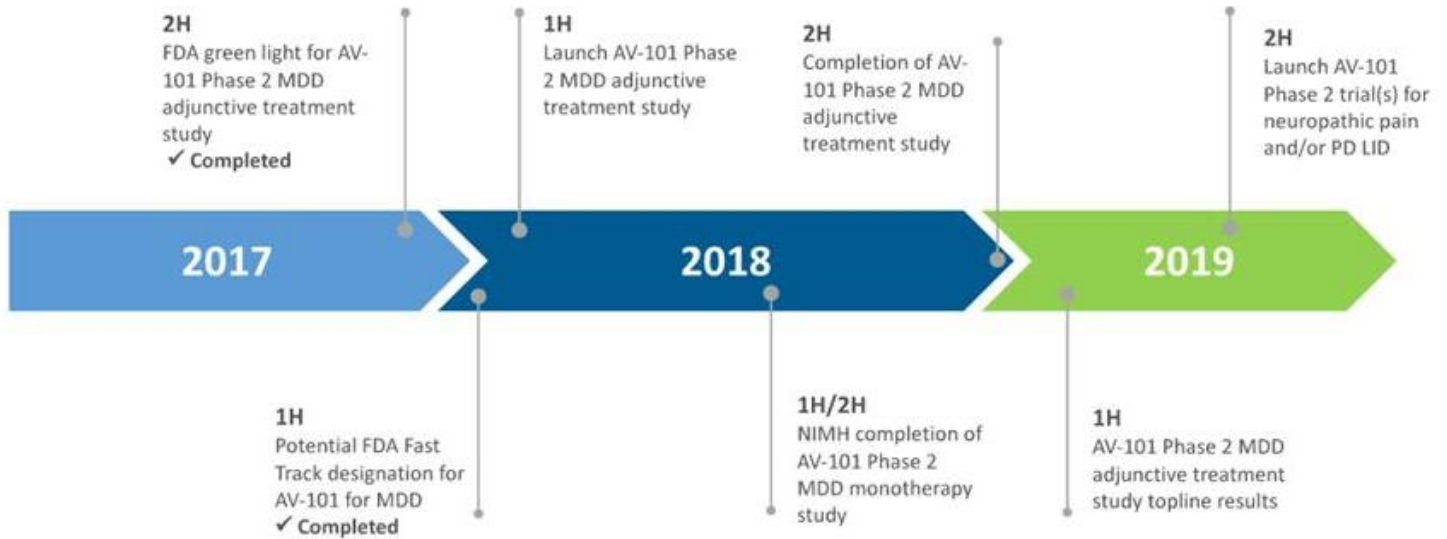
AV-101 reduced mean dyskinesia scores by 30% in Parkinsonian monkeys with LID, without affecting Parkinson's symptoms

### NEXT STEP

**Phase 2 study of AV-101 vs placebo in Parkinson's patients**



## Short Time Horizon to Potential Clinical Catalysts





## High-Value Peer/Pharma M&A Underscores Upside Potential



### Rapastinel

- New generation antidepressant candidate
- Similar MOA to AV-101 (NMDAR/AMPA)
- Ketamine-like antidepressant effects, without ketamine's side effects
- **IV only**



### Acquired by Allergan after Phase 2

- **\$571 million** in cash at closing
- **\$1.0+ billion** in potential milestone payments

## Preeminent CNS Clinical and Regulatory Advisors



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### **Maurizio Fava, M.D.**

Professor of Psychiatry, Harvard Medical School; Director, Division of Clinical Research, Massachusetts General Hospital (MGH) Research Institute; Executive Director, MGH Clinical Trials Network and Institute

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### **Thomas Laughren, M.D.**

Director (retired), U.S. Food and Drug Administration (FDA) Division of Psychiatry Products, Office of New Drugs, Center for Drug Evaluation and Research (CDER)

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### **Sanjay Mathew, M.D.**

Associate Professor of Psychiatry and Behavioral Sciences, Marjorie Bintliff Johnson and Raleigh White Johnson; Jr. Chair for Research in Psychiatry and Menninger Department of Psychiatry & Behavioral Sciences, Baylor College of Medicine

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### **Gerard Sanacora, Ph.D., M.D.**

Professor of Psychiatry, Yale School of Medicine; Director, Yale Depression Research Program; Scientific Director, Yale-New Haven Hospital Interventional Psychiatry Service

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### **Mark Wallace, M.D.**

Professor of Clinical Anesthesiology, Chair of the Division of Pain Medicine, Medical Director and Director at the University of California, San Diego

## Experienced Team Leading Execution

### Ralph Snodgrass, Ph.D. President, Chief Scientific Officer

- 23 years of experience in senior biotechnology management
- Progenitor; Lineberger Comprehensive Cancer Center



### Shawn K. Singh Chief Executive Officer

- 25 years of experience with biopharmaceutical companies, a healthcare venture capital firm and a profitable CRO
- Artemis Neuroscience; SciClone Pharmaceuticals; Cato BioVentures; Cato Research; Morrison & Foerster



### Jerrold D. Dotson, CPA Chief Financial Officer, Secretary

- 20 years of experience in senior management finance and administration
- Calypte Biomedical; Discovery Foods; California & Hawaiian Sugar; Clorox

### Mark A. Smith, M.D., Ph.D. Chief Medical Officer

- 20 years of large Pharma CNS drug development experience
- Teva Pharmaceuticals; Shire Pharmaceuticals; AstraZeneca Pharmaceuticals; DuPont Pharmaceutical Company; U.S. National Institute of Mental Health



### Mark A. McPartland Vice President, Corporate Development

- 20 years of experience in corporate development, capital markets and management consulting
- Stellar Biotechnologies; MZ Group; Hayden Communications; Alliance Advisors

# VistaGen Highlights

NASDAQ: VTGN



Clinical-stage, focused on depression, pain and PD LID



AV-101, oral new generation antidepressant; oral non-opioid alternative for neuropathic pain



Phase 2 for MDD in 2018; planning Phase 2 for pain and PD LID in 2019



Potentially transformative catalysts in 2018 and 2019



Strong support from NIH




Experienced team



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Therapeutics

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DEVELOPING NEW GENERATION MEDICINES FOR DEPRESSION AND OTHER CNS DISORDERS