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Registration No. 333-231441

PROSPECTUS

CATABASIS PHARMACEUTICALS, INC.

Up to $50,000,000

Common Stock

We have entered into a sales agreement with Cowen and Company, LLC, or Cowen, dated May 14, 2019, relating to the sale of shares of our common stock, $0.001 par value per share, offered by this prospectus. In accordance with the terms of the sales agreement, under this prospectus we may offer and sell shares of our common stock having an aggregate offering price of up to $50,000,000 from time to time through Cowen, acting as our agent.

Our common stock is listed on the Nasdaq Global Market under the symbol "CATB." On May 21, 2019, the last reported sale price of our common stock on the Nasdaq Global Market was $8.22 per share.

Sales of our common stock, if any, under this prospectus will be made by any method permitted that is deemed an "at the market offering" as defined in Rule 415(a)(4) under the Securities Act of 1933, as amended, or the Securities Act. Cowen is not required to sell any specific amount, but will act as our sales agent using commercially reasonable efforts consistent with its normal trading and sales practices and applicable state and federal laws, rules and regulations and the rules of the Nasdaq Stock Market, LLC. There is no arrangement for funds to be received in any escrow, trust or similar arrangement.

Cowen will be entitled to compensation at a commission rate equal to 3.0% of the gross sales price per share sold under the sales agreement. See "Plan of Distribution" beginning on page 15 for additional information regarding the compensation to be paid to Cowen. In connection with the sale of the common stock on our behalf, Cowen will be deemed to be an "underwriter" within the meaning of the Securities Act and the compensation of Cowen will be deemed to be underwriting commissions or discounts. We have also agreed to provide indemnification and contribution to Cowen with respect to certain liabilities, including liabilities under the Securities Act.

We are an "emerging growth company" as that term is used in the Jumpstart Our Business Startups Act of 2012 and, as such, have elected to comply with certain reduced public company reporting requirements.

Investing in these securities involves risks. See "Risk Factors" on page 7 of this prospectus and in the documents incorporated by reference herein for a discussion of the factors you should carefully consider before deciding to purchase our common stock.

Neither the Securities and Exchange Commission nor any state securities commission has approved or disapproved of these securities or passed upon the adequacy or accuracy of this prospectus. Any representation to the contrary is a criminal offense.

Cowen

The date of this prospectus is May 23, 2019

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ABOUT THIS PROSPECTUS

This prospectus is part of a registration statement that we filed with the Securities and Exchange Commission, or the SEC, utilizing a "shelf" registration process. Under this shelf registration process, we may from time to time sell shares of our common stock having an aggregate offering price of up to $250,000,000. Under this prospectus, we may from time to time sell shares of our common stock having an aggregate offering price of up to $50,000,000, at prices and on terms to be determined by market conditions at the time of the offering. The $50,000,000 of shares of our common stock that may be sold under this prospectus are included in the $250,000,000 of shares of common stock that may be sold under the registration statement.

Before you invest, you should carefully read this prospectus and all information incorporated by reference herein, as well as the additional information described under "Where You Can Find More Information" on page 2 of this prospectus. These documents contain information you should consider when making your investment decision.

To the extent there is a conflict between the information contained in this prospectus, on the one hand, and the information contained in any document incorporated by reference in this prospectus that was filed prior to the date of this prospectus, on the other hand, you should rely on the information in this prospectus. If any statement in one of these documents is inconsistent with a statement in another document having a later date—for example, a document filed after the date of this prospectus and incorporated by reference in this prospectus—the statement in the document having the later date modifies or supersedes the earlier statement.

You should rely only on the information contained or incorporated by reference in this prospectus and in any free writing prospectuses we may provide to you in connection with this offering. We have not, and Cowen has not, authorized any other person to provide you with any information that is different. If anyone provides you with different or inconsistent information, you should not rely on it. We are offering to sell, and seeking offers to buy, shares of our common stock only in jurisdictions where offers and sales are permitted. The distribution of this prospectus and the offering of the common stock in certain jurisdictions may be restricted by law. Persons outside the United States who come into possession of this prospectus must inform themselves about, and observe any restrictions relating to, the offering of the common stock and the distribution of this prospectus outside the United States. This prospectus does not constitute, and may not be used in connection with, an offer to sell, or a solicitation of an offer to buy, any securities offered by this prospectus by any person in any jurisdiction in which it is unlawful for such person to make such an offer or solicitation.

We further note that the representations, warranties and covenants made by us in any agreement that is filed as an exhibit to any document that is incorporated by reference in this prospectus were made solely for the benefit of the parties to such agreement, including, in some cases, for the purpose of allocating risk among the parties to such agreements, and should not be deemed to be a representation, warranty or covenant to you. Moreover, such representations, warranties or covenants were accurate only as of the date when made. Accordingly, such representations, warranties and covenants should not be relied on as accurately representing the current state of our affairs.

Unless the context otherwise indicates, references in this prospectus to "we," "our" and "us" refer, collectively, to Catabasis Pharmaceuticals, Inc., a Delaware corporation, and its consolidated subsidiary.

WHERE YOU CAN FIND MORE INFORMATION

We file annual, quarterly and current reports, proxy statements and other information with the Securities and Exchange Commission, or SEC. Our SEC filings are available to the public over the Internet at the SEC's website at http://www.sec.gov. Copies of certain information filed by us with the SEC are also available on our website at www.catabasis.com. Our website is not a part of this prospectus and is not incorporated by reference in this prospectus.

This prospectus is part of a registration statement we filed with the SEC. This prospectus omits some information contained in the registration statement in accordance with SEC rules and regulations. You should review the information and exhibits in the registration statement for further information about us and our consolidated subsidiary and the securities we are offering. Statements in this prospectus concerning any document we filed as an exhibit to the registration statement or that we otherwise filed with the SEC are not intended to be comprehensive and are qualified by reference to these filings. You should review the complete document to evaluate these statements.

INCORPORATION BY REFERENCE

The SEC allows us to incorporate by reference much of the information we file with the SEC, which means that we can disclose important information to you by referring you to those publicly available documents. The information that we incorporate by reference in this prospectus is considered to be part of this prospectus. Because we are incorporating by reference future filings with the SEC, this prospectus is continually updated and those future filings may modify or supersede some of the information included or incorporated in this prospectus. This means that you must look at all of the SEC filings that we incorporate by reference to determine if any of the statements in this prospectus or in any document previously incorporated by reference have been modified or superseded. This prospectus incorporates by reference the documents listed below (File No. 001-37467) and any future filings we make with the SEC under Sections 13(a), 13(c), 14 or 15(d) of the Securities Exchange Act of 1934, as amended, or the Exchange Act, (in each case, other than those documents or the portions of those documents not deemed to be filed) following the effectiveness of the registration statement until the offering of the securities under the registration statement is terminated or completed:

1. our Annual Report on Form 10-K for the year ended December 31, 2018, including the information specifically incorporated by reference into our Annual Report on Form 10-K for the fiscal year ended December 31, 2018 from our definitive proxy statement on Schedule 14A filed with the SEC on April 22, 2019;

2. our Quarterly Reports on Form 10-Q for the quarterly period ended March 31, 2019;

3. our Current Reports on Form 8-K filed with the SEC on January 9, 2019, February 6, 2019, February 14, 2019; and

4. the description of our common stock contained in our Registration Statement on Form 8-A filed on June 23, 2015, including any amendments or reports filed for the purpose of updating such description.

You may request a copy of these filings, at no cost, by writing or telephoning us at the following address or telephone number:

Catabasis Pharmaceuticals, Inc.
One Kendall Square
Building 1400E, Suite B14202
Cambridge, MA 02139
Attn: Investor Relations
(617) 349-1971

FORWARD-LOOKING STATEMENTS

This prospectus and the information incorporated by reference in this prospectus include "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933, as amended, or the Securities Act, and Section 21E of the Exchange Act. All statements, other than statements of historical facts, contained or incorporated by reference in this prospectus, including statements regarding our strategy, future operations, future financial position, future revenue, projected costs, prospects, plans and objectives of management and expected market growth are forward-looking statements. The words "anticipate," "believe," "continue," "could," "estimate," "expect," "intend," "may," plan," "potential," "predict," "project," "should," "target," "would" and similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words.

These forward-looking statements include, among other things, statements about:

- our expectations regarding our ability to successfully conduct the PolarisDMD trial, and our expectations regarding the timing and results of such trial, including reporting top-line results of this trial in the second half of 2020 and the potential consistency of data produced by this trial with prior results from our MoveDMD® trial, as well as any new data and analyses relating to the safety profile and potential clinical benefits of edasalonexent;
- our expectations regarding our ability to successfully conduct the GalaxyDMD open-label extension trial, including the anticipated announcement of data from this trial;
- our plans to identify, develop and commercialize novel therapeutics based on our SMART Linker™ drug discovery platform;
- ongoing and planned clinical trials for edasalonexent and other product candidates, whether conducted by us or by any future collaborators, including the timing of initiation of these trials and the anticipated announcement of results;
- our plans to enter into collaborations for the development and commercialization of product candidates;
- the potential benefits of any future collaboration;
- our ability to receive research and development funding and achieve anticipated milestones under any future collaborations;
- the timing of and our ability to obtain and maintain regulatory approvals for our product candidates;
- the rate and degree of market acceptance and clinical utility of any products for which we receive marketing approval;
- our commercialization, marketing and manufacturing capabilities and strategy;
- our intellectual property position and strategy;
- our ability to identify additional products or product candidates with significant commercial potential;
- our estimates regarding expenses, future revenue, capital requirements and needs for additional financing;
- developments relating to our competitors and our industry; and
- the impact of government laws and regulations.

You are cautioned that these forward-looking statements are only predictions and are subject to risks, uncertainties and assumptions, including those referenced in the section of this prospectus entitled "Risk Factors" and in the sections entitled "Risk Factors" in our most recent Annual Report on Form 10-K and the other filings we make with the Securities and Exchange Commission, or the SEC, from time to time that are incorporated by reference herein. We undertake no obligation to revise or update any forward-looking statements, except to the extent required by law.

PROSPECTUS SUMMARY

About Catabasis Pharmaceuticals, Inc.

This summary highlights certain information about us, this offering and selected information contained elsewhere in or incorporated by reference into this prospectus, and the information incorporated by reference herein. This summary is not complete and does not contain all of the information that you should consider before deciding whether to invest in our common stock. For a more complete understanding of our company and this offering, we encourage you to read and consider carefully the entire prospectus, including "Risk Factors" beginning on page 7 of this prospectus, along with our consolidated financial statements and notes to those consolidated financial statements and the other documents incorporated by reference in this prospectus.

Overview

We are a clinical-stage biopharmaceutical company. Our lead program is edasalonexent, formerly known as CAT-1004, an oral small molecule designed to inhibit NF-κB, or nuclear factor kappa-light-chain-enhancer of activated B cells, in development for the treatment of Duchenne muscular dystrophy, or DMD. We believe edasalonexent has the potential to be a foundational therapy for all patients affected by DMD, regardless of the underlying dystrophin mutation. DMD is an ultimately fatal genetic disorder involving progressive muscle degeneration. The United States Food and Drug Administration, or FDA, has granted orphan drug, fast track and rare pediatric disease designations to edasalonexent for the treatment of DMD. The European Commission, or EC, has granted orphan medicinal product designation to edasalonexent for the treatment of DMD.

We initiated a global Phase 3 trial of edasalonexent for the treatment of DMD in September 2018, which we refer to as the PolarisDMD trial. The PolarisDMD trial is designed to evaluate the efficacy and safety of edasalonexent for registration purposes. The PolarisDMD trial is active in seven countries and enrolling patients globally, with enrollment expected to be completed in 2019. Top-line results from the trial are expected in the second half of 2020. Our goal is to submit a New Drug Application for edasalonexent for the treatment of DMD in early 2021. The trial design was informed by discussions with the FDA, as well as input from treating physicians, families of boys affected by DMD and patient advocacy organizations.

The Phase 3 PolarisDMD trial is a randomized, double-blind, placebo-controlled trial, and we anticipate enrolling approximately 125 patients between the ages of four and seven (up to eighth birthday), regardless of mutation type, who have not been on steroids for at least six months. The primary efficacy endpoint is change in North Star Ambulatory Assessment, or NSAA, score after 12 months of treatment with edasalonexent compared to placebo. Key secondary endpoints are the age-appropriate timed function tests: time to stand, 4-stair climb and 10-meter walk/run. Assessments of growth, cardiac and bone health are also included in the trial.

Our MoveDMD Phase 1/2 trial enrolled ambulatory boys four to seven years old with a genetically confirmed diagnosis of DMD who were steroid naive or had not used steroids for at least six months prior to the trial. Boys enrolled in the trial were not limited to any specific dystrophin mutations and the 31 boys in the trial had 26 different dystrophin mutations. The MoveDMD trial was designed to be conducted in three sequential parts, Phase 1 and Phase 2, both of which are completed, and an open-label extension, which is on-going. In Phase 1 of the MoveDMD trial, we assessed the safety, tolerability and pharmacokinetics of edasalonexent in 17 patients, following seven days of dosing, and we reported in January 2016 that all three doses of edasalonexent tested were generally well tolerated with no safety signals observed and there were no serious adverse events and no drug discontinuations. In the Phase 2 portion of the trial, we assessed the effects of edasalonexent using magnetic resonance imaging, or MRI, T2 as an early biomarker at 12 weeks, and announced in January 2017 that the primary efficacy endpoint of average change from baseline to week 12 in the MRI T2 composite

measure of lower leg muscles for the pooled edasalonexent treatment groups compared to placebo was not met, although we observed directionally positive results in the 100/mg/kg/day edasalonexent treatment group that were not statistically significant. Subsequently, in the open-label extension of the MoveDMD trial, we observed improvement in the rate of change in lower leg composite MRI T2 through 72 weeks on 100 mg/kg of edasalonexent treatment compared to the off-treatment control period.

We have completed key efficacy and safety assessments from the MoveDMD trial. In the ongoing open-label extension of the MoveDMD trial through 72 weeks of oral 100 mg/kg/day edasalonexent treatment, we observed preserved muscle function and consistent improvements in all four assessments of muscle function: NSAA score, time to stand, 4-stair climb and 10-meter walk/run, compared to the rates of change in the control period for boys prior to receiving edasalonexent treatment. Additionally, supportive changes in non-effort-based measures of muscle health were seen, supporting the durability of edasalonexent treatment effects. Specifically, we observed, in the 100 mg/kg/day treatment group, that all four muscle enzymes tested (creatine kinase, alanine aminotransferase, aspartate aminotransferase and lactate dehydrogenase) were significantly decreased compared to baseline following edasalonexent treatment at 12 weeks and later time points through 72 weeks ($p<0.05$). Through 72 weeks of treatment, edasalonexent continued to be well tolerated with no safety signals observed in the MoveDMD trial. Boys treated with edasalonexent continued to follow age-appropriate growth curves with age-appropriate increases in weight and height and overall body mass index trended down to age-normative values. We also observed that the heart rate of the boys significantly decreased toward age-normative values with over a year and a half period of edasalonexent treatment.

In March 2019, we initiated a new open-label extension trial, which we refer to as the GalaxyDMD trial. As we complete the MoveDMD trial, all of the boys participating in the MoveDMD trial open-label extension are given the opportunity to transition to the GalaxyDMD trial. When boys complete the 12-month PolarisDMD trial, they are given the opportunity to receive open-label edasalonexent in the GalaxyDMD trial. The GalaxyDMD trial is designed to provide longer term safety data to support registration filings.

In addition to edasalonexent, we have developed CAT-5571 as a potential treatment for cystic fibrosis, or CF. CAT-5571 is an oral small molecule that is designed to activate autophagy, a mechanism for recycling cellular components and digesting pathogens, which is important for host defenses and is depressed in CF. We have completed investigational new drug, or IND, application-enabling activities for CAT-5571.

THE OFFERING

Common stock offered by us	Shares of our common stock having an aggregate offering price of up to $50,000,000.
Common stock to be outstanding after this offering	17,578,967 shares, assuming the sale of 6,082,725 shares of our common stock in this offering at an offering price of $8.22 per share, which was the last reported sale price of our common stock on the Nasdaq Global Market on May 21, 2019. The actual number of shares issued will vary depending on the sales price under this offering.
Manner of offering	"At the market offering" that may be made from time to time through our sales agent, Cowen and Company, LLC. See the section entitled "Plan of Distribution" on page 15 of this prospectus.
Use of proceeds	We currently estimate that we will use the net proceeds from this offering to fund our ongoing and planned clinical trials of edasalonexent, to fund market development activities for edasalonexent, to fund research and development to advance our pipeline, and for working capital and other general corporate purposes. See the section entitled "Use of Proceeds" on page 12 of this prospectus.
Risk factors	See "Risk Factors" beginning on page 7 of this prospectus, as well as the other information included in or incorporated by reference in this prospectus, for a discussion of certain factors you should carefully consider before deciding to invest in shares of our common stock.
Nasdaq Global Market symbol	"CATB"

The number of shares of our common stock to be outstanding after this offering is based on 11,496,242 shares of our common stock outstanding as of March 31, 2019.

The number of shares of our common stock to be outstanding after this offering excludes:

- 758,304 shares of our common stock issuable upon the exercise of stock options outstanding as of March 31, 2019 at a weighted-average exercise price of $18.16 per share;
- 553,014 shares of our common stock available for future issuance as of March 31, 2019 under our 2015 stock incentive plan;
- 112,481 shares of our common stock available for future issuance as of March 31, 2019 under our 2015 employee stock purchase plan;
- 6,201,949 shares of our common stock that had been reserved for issuance in connection with warrants outstanding as of March 31, 2019, including the Warrants, at a weighted-average exercise price of $10.19 per share.

Unless otherwise indicated, all information in this prospectus reflects and assumes:

- a one-for-ten reverse stock split of our common stock that was effected on December 28, 2018; and
- no exercise of the outstanding options or warrants described above.

RISK FACTORS

An investment in our common stock involves a high degree of risk. Before deciding whether to invest in our common stock, you should consider carefully the risks and uncertainties described below and under the section captioned "Risk Factors" contained in our most recent Annual Report on Form 10-K and other filings we make with the SEC from time to time, which are incorporated by reference herein in their entirety, together with other information in this prospectus and the information incorporated by reference herein and in any free writing prospectus that we may authorize for use in connection with this offering. If any of these risks actually occurs, our business, financial condition, results of operations or cash flow could suffer materially. In such event, the trading price of our common stock could decline and you might lose all or part of your investment.

Risks Related to This Offering

If you purchase shares of common stock in this offering, you will suffer immediate dilution of your investment.

The shares sold in this offering, if any, will be sold from time to time at various prices. However, the expected offering price of our common stock will be substantially higher than the net tangible book value per share of our common stock. Therefore, if you purchase shares of our common stock in this offering, you will pay a price per share that substantially exceeds our net tangible book value per share after this offering. You will experience immediate dilution of $2.64 per share, representing the difference between our as adjusted net tangible book value per share after giving effect to the sale of 6,082,725 shares in this offering and the assumed offering price of $8.22 per share, the last reported sale price of our common stock on The Nasdaq Global Market on May 21, 2019. To the extent outstanding options are exercised, you will incur further dilution.

You may experience future dilution as a result of future equity offerings.

In order to raise additional capital, we may in the future offer additional shares of our common stock or other securities convertible into or exchangeable for our common stock at prices that may not be the same as the price per share in this offering. We may sell shares or other securities in any other offering at a price per share that is less than the price per share paid by investors in this offering, and investors purchasing shares or other securities in the future could have rights superior to existing stockholders. The price per share at which we sell additional shares of our common stock, or securities convertible or exchangeable into common stock, in future transactions may be higher or lower than the price per share paid by investors in this offering.

We have broad discretion over the use of our cash and cash equivalents, including the net proceeds we receive in this offering, and may not use them effectively.

Our management has broad discretion to use our cash and cash equivalents, including the net proceeds we receive in this offering, to fund our operations and could spend these funds in ways that do not improve our results of operations or enhance the value of our common stock. The failure by our management to apply these funds effectively could result in financial losses that could have a material adverse effect on our business, cause the price of our common stock to decline and delay the development of our product candidates. Pending their use to fund operations, we may invest our cash and cash equivalents in a manner that does not produce income or that loses value.

DESCRIPTION OF CAPITAL STOCK

The following description of our capital stock is intended as a summary only and therefore is not a complete description of our capital stock. This description is based upon, and is qualified by reference to, our certificate of incorporation, our by-laws and applicable provisions of Delaware corporate law. You should read our certificate of incorporation and by-laws, which are filed as exhibits to the registration statement of which this prospectus forms a part, for the provisions that are important to you.

Our authorized capital stock consists of 150,000,000 shares of common stock, $0.001 par value per share, and 5,000,000 shares of preferred stock, $0.001 par value per share. As of March 31, 2019, 11,496,242 shares of common stock were outstanding and no shares of preferred stock were outstanding.

Common Stock

Voting Rights. Holders of our common stock are entitled to one vote for each share held on all matters submitted to a vote of stockholders, except that unless otherwise required by law, holders of our common stock are not entitled to vote on any amendment to the certificate of incorporation that relates solely to the terms of one or more outstanding series of preferred stock, if the holders of such affected series are entitled, either separately or together as a class with the holders of one or more such other series, to vote thereon pursuant to the certificate of incorporation. Holders of our common stock do not have cumulative voting rights.

An election of directors will be decided by a plurality of the votes cast by the stockholders entitled to vote on the election at a duly held stockholders' meeting at which a quorum is present. All other questions will be decided by a majority of the votes cast by stockholders entitled to vote thereon at a duly held meeting of stockholders at which a quorum is present, except when a different vote is required by law, our certificate of incorporation or by-laws.

Dividends. Holders of common stock are entitled to receive proportionately any dividends as may be declared by our board of directors, subject to any preferential dividend or other rights of any series of preferred stock that we may designate and issue in the future.

Liquidation and Dissolution. In the event of our liquidation or dissolution, the holders of common stock are entitled to receive proportionately our net assets available for distribution to stockholders after the payment of all debts and other liabilities and subject to the prior rights of any outstanding preferred stock.

Other Rights. Holders of common stock have no preemptive, subscription, redemption or conversion rights. The rights, preferences and privileges of holders of common stock are subject to and may be adversely affected by the rights of the holders of shares of any series of preferred stock that we may designate and issue in the future.

Transfer Agent and Registrar. The transfer agent and registrar for our common stock is American Stock Transfer & Trust Company, LLC.

Listing on The Nasdaq Global Market. Our common stock is listed on The Nasdaq Global Market under the symbol "CATB."

Preferred Stock

We currently have no outstanding shares of preferred stock. Under our restated certificate of incorporation, we are authorized to issue "blank check" preferred stock, which may be issued in one or more series upon authorization of our board of directors. Our board of directors is authorized to fix

the designation of the series, the number of authorized shares of the series, dividend rights and terms, conversion rights, voting rights, redemption rights and terms, liquidation preferences and any other rights, powers, preferences and limitations applicable to each series of preferred stock. The authorized shares of our preferred stock are available for issuance without further action by our stockholders, unless such action is required by applicable law or the rules of any stock exchange on which our securities may be listed. If the approval of our stockholders is not required for the issuance of shares of our preferred stock, our board may determine not to seek stockholder approval.

A series of our preferred stock could, depending on the terms of such series, impede the completion of a merger, tender offer or other takeover attempt. Our board of directors will make any determination to issue preferred shares based upon its judgment as to the best interests of our stockholders. Our directors, in so acting, could issue preferred stock having terms that could discourage an acquisition attempt through which an acquirer may be able to change the composition of our board of directors, including a tender offer or other transaction that some, or a majority, of our stockholders might believe to be in their best interests or in which stockholders might receive a premium for their stock over the then-current market price of the stock.

Stock Options

As of March 31, 2019, options to purchase 758,304 shares of our common stock at a weighted-average exercise price of $18.16 per share were outstanding, of which options to purchase 197,643 shares of our common stock were exercisable, at a weighted-average exercise price of $46.85 per share.

Warrants

As of March 31, 2019, we had outstanding warrants to purchase shares of our common stock exercisable for an aggregate of 6,201,949 shares of our common stock at a weighted-average exercise price of $10.19 per share.

Registration Rights

Our second amended and restated investor rights agreement, or the Investor Rights Agreement, provides certain holders of our preferred stock, including some of our directors and 5% stockholders and their respective affiliates and entities affiliated with our officers and directors, the right to require us to file registration statements under the Securities Act covering their shares or to include their shares in registration statements that we may file for ourselves or other stockholders. In addition, the holders of warrants to purchase shares of our preferred stock have rights under those warrants to become party to the Investor Rights Agreement following exercise of the warrants, following which they will have, with respect to the shares acquired on exercise of the warrants, the same rights to require us to register the shares as the other investor parties to the Investor Rights Agreement. After registration pursuant to these rights, these shares will become freely tradable without restriction under the Securities Act in the public market, subject to volume limitations applicable to affiliates.

Demand Registration Rights. Subject to specified limitations set forth in the Investor Rights Agreement, at any time the holders of a majority of then outstanding registrable securities, as defined in the Investor Rights Agreement, acting together, may demand in writing that we register their registrable securities under the Securities Act so long as the total amount of registrable shares requested to be registered has an anticipated aggregate offering price to the public, net of selling expenses, of least $10.0 million. We are not obligated to file a registration statement pursuant to this demand provision on more than two occasions, subject to specified exceptions.

In addition, at any time when we are eligible to file a registration statement on Form S-3 under the Securities Act, subject to specified limitations, the holders of at least 35% of the registrable securities then outstanding may demand in writing that we register on Form S-3 registrable shares held

by them so long as the total amount of registrable shares requested to be registered has an anticipated aggregate offering price to the public, net of selling expenses, of least $1.0 million.

Incidental Registration Rights. If we propose to file a registration statement to register any of our securities under the Securities Act, either for our own account or for the account of any of our stockholders that are not holders of registrable shares, solely for cash and on a form that would also permit the registration of registrable shares, the holders of our registrable shares are entitled to notice of registration and, subject to specified exceptions, we will be required to register the registrable shares then held by them that they request that we register.

Expenses. Pursuant to the Investor Rights Agreement, we are required to pay all registration expenses, including registration fees, printing expenses, fees and disbursements of our counsel and accountants and reasonable fees and disbursements of one counsel representing the selling stockholders, other than any underwriting discounts and commissions, related to any demand or incidental registration. The Investor Rights Agreement contains customary cross-indemnification provisions, pursuant to which we are obligated to indemnify the selling stockholders in the event of material misstatements or omissions in the registration statement attributable to us, and they are obligated to indemnify us for material misstatements or omissions in the registration statement attributable to them.

Provisions of Our Certificate of Incorporation and By-laws and Delaware Law That May Have Anti-Takeover Effects

Delaware law, our certificate of incorporation and our by-laws contain provisions that could have the effect of delaying, deferring or discouraging another party from acquiring control of us. These provisions, which are summarized below, are expected to discourage coercive takeover practices and inadequate takeover bids. These provisions are also designed to encourage persons seeking to acquire control of us to first negotiate with our board of directors.

Staggered Board; Removal of Directors. Our certificate of incorporation and by-laws divide our board of directors into three classes with staggered three-year terms. In addition, a director is only able to be removed for cause and only by the affirmative vote of the holders of at least 75% of the votes that all of our stockholders would be entitled to cast in an annual election of directors. Any vacancy on our board of directors, including a vacancy resulting from an enlargement of our board of directors, is only able to be filled by vote of a majority of our directors then in office. The classification of our board of directors and the limitations on the removal of directors and filling of vacancies could make it more difficult for a third party to acquire, or discourage a third party from seeking to acquire, control of our company.

Stockholder Action by Written Consent; Special Meetings. Our certificate of incorporation provides that any action required or permitted to be taken by our stockholders must be effected at a duly called annual or special meeting of our stockholders and may not be effected by any consent in writing by our stockholders. Our certificate of incorporation and by-laws also provide that, except as otherwise required by law, special meetings of our stockholders can only be called by our chairman of the board, our chief executive officer or our board of directors.

Advance Notice Requirements for Stockholder Proposals. Our by-laws establish an advance notice procedure for stockholder proposals to be brought before an annual meeting of stockholders, including proposed nominations of persons for election to our board of directors. Stockholders at an annual meeting are only able to consider proposals or nominations specified in the notice of meeting or brought before the meeting by or at the direction of our board of directors or by a stockholder of record on the record date for the meeting who is entitled to vote at the meeting and who has delivered timely written notice in proper form to our secretary of the stockholder's intention to bring such

business before the meeting. These provisions could have the effect of delaying until the next stockholder meeting stockholder actions that are favored by the holders of a majority of our outstanding voting securities.

Delaware Business Combination Statute. We are subject to Section 203 of the General Corporation Law of the State of Delaware. Subject to certain exceptions, Section 203 prevents a publicly held Delaware corporation from engaging in a "business combination" with any "interested stockholder" for three years following the date that the person became an interested stockholder, unless the interested stockholder attained such status with the approval of our board of directors or unless the business combination is approved in a prescribed manner. A "business combination" includes, among other things, a merger or consolidation involving us and the "interested stockholder" and the sale of more than 10% of our assets. In general, an "interested stockholder" is any entity or person beneficially owning 15% or more of our outstanding voting stock and any entity or person affiliated with or controlling or controlled by such entity or person.

Amendment of Certificate of Incorporation and By-laws. The General Corporation Law of the State of Delaware provides generally that the affirmative vote of a majority of the shares entitled to vote on any matter is required to amend a corporation's certificate of incorporation or by-laws, unless a corporation's certificate of incorporation or by-laws, as the case may be, requires a greater percentage. Our by-laws may be amended or repealed by a majority vote of our board of directors or by the affirmative vote of the holders of at least 75% of the votes that all of our stockholders would be entitled to cast in any annual election of directors. In addition, the affirmative vote of the holders of at least 75% of the votes that all of our stockholders would be entitled to cast in any annual election of directors is required to amend or repeal or to adopt any provisions inconsistent with any of the provisions of our certificate of incorporation described above under "*—Staggered Board; Removal of Directors*" and "*—Stockholder Action by Written Consent; Special Meetings*."

Exclusive Forum Selection. Our certificate of incorporation provides that, unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware (or if the Court of Chancery does not have jurisdiction, the federal district court for the District of Delaware) shall be the sole and exclusive forum for (1) any derivative action or proceeding brought on behalf of our company, (2) any action asserting a claim of breach of a fiduciary duty owed by any of our directors, officers or employees to our company or our stockholders, (3) any action asserting a claim against our company arising pursuant to any provision of the General Corporation Law of the State of Delaware or our certificate of incorporation or by-laws, or (4) any action asserting a claim against our company governed by the internal affairs doctrine. Although our certificate of incorporation contains the choice of forum provision described above, it is possible that a court could rule that such a provision is inapplicable for a particular claim or action or that such provision is unenforceable.

Authorized but Unissued Shares. Our authorized but unissued shares of common stock and preferred stock are available for future issuance without stockholder approval, subject to any limitations imposed by the listing requirements of the Nasdaq Global Market. These additional shares may be used for a variety of corporate finance transactions, acquisitions and employee benefit plans. The existence of authorized but unissued and unreserved common stock and preferred stock could make it more difficult or discourage an attempt to obtain control of us by means of a proxy contest, tender offer, merger or otherwise.

USE OF PROCEEDS

We may issue and sell shares of our common stock having aggregate gross sales proceeds of up to $50,000,000 from time to time (before deducting sales agent commissions and expenses) Because there is no minimum offering amount required as a condition to close this offering, the actual total public offering amount, commissions and proceeds to us, if any, are not determinable at this time.

We intend to use the net proceeds from this offering to fund our ongoing and planned clinical trials of edasalonexent, to fund market development activities for edasalonexent, to fund research and development to advance our pipeline, and for working capital and other general corporate purposes. General corporate purposes may include research and development expenditures, repayment and refinancing of debt, and working capital and capital expenditures. We have not determined the amount of net proceeds to be used specifically for such purposes. As a result, management will retain broad discretion over the allocation of the net proceeds.

DIVIDEND POLICY

We have never declared or paid any cash dividends on our capital stock. We currently intend to retain earnings, if any, to finance the growth and development of our business. We do not intend to pay cash dividends in respect of our common stock in the foreseeable future. Payment of future dividends, if any, will be at the discretion of our board of directors and will depend on our financial condition, results of operations, capital requirements, restrictions contained in current or future financing instruments, provisions of applicable law and other factors the board deems relevant.

DILUTION

If you invest in our common stock, your interest will be diluted to the extent of the difference between the price per share you pay in this offering and the net tangible book value per share of our common stock immediately after this offering. Our net tangible book value as of March 31, 2019 was approximately $49.9 million, or approximately $4.34 per share of common stock based upon 11,496,242 shares outstanding. Net tangible book value per share is equal to our total tangible assets, less our total liabilities, divided by the total number of shares outstanding as of March 31, 2019.

After giving effect to the sale of the 6,082,725 shares of our common stock that may be sold in this offering at an assumed offering price of $8.22 per share, the last reported sale price of our common stock on The Nasdaq Global Market on May 21, 2019, and after deducting commissions and estimated offering expenses payable by us, our as adjusted net tangible book value as of March 31, 2019 would have been $98.2 million, or $5.58 per share of common stock. This represents an immediate increase in net tangible book value of $1.24 per share to our existing stockholders and an immediate dilution of $2.64 per share to new investors in this offering. The following table illustrates this calculation on a per share basis. The as adjusted information is illustrative only and will adjust based on the actual price to the public, the actual number of shares sold and other terms of the offering determined at the time shares of our common stock are sold pursuant to this prospectus. The as adjusted information assumes that all of the $50,000,000 aggregate offering amount of our common stock that may be sold in this offering is sold at the assumed offering price of $8.22 per share, the last reported sale price of our common stock on The Nasdaq Global Market on May 21, 2019. The shares sold in this offering, if any, will be sold from time to time at various prices.

Assumed offering price per share		$ 8.22
Net tangible book value per share as of March 31, 2019	$ 4.34	
Increase in net tangible book value per share attributable to the offering	$ 1.24	
As adjusted net tangible book value per share after giving effect to the offering		$ 5.58
Dilution per share to new investors participating in the offering		$ 2.64

The number of shares of our common stock to be outstanding immediately after this offering is based on 11,496,242 shares of our common stock outstanding as of March 31, 2019. The number of shares outstanding as of March 31, 2019 excludes:

- 758,304 shares of our common stock issuable upon the exercise of stock options outstanding as of March 31, 2019, at a weighted-average exercise price of $18.16 per share;
- 553,014 shares of our common stock available for future issuance as of March 31, 2019 under our 2015 stock incentive plan;
- 6,201,949 shares of our common stock issuable upon the exercise of warrants outstanding as of March 31, 2019, at a weighted-average exercise price of $10.19 per share; and
- 112,481 shares of our common stock available for future issuance as of March 31, 2019 under our 2015 employee stock purchase plan.

PLAN OF DISTRIBUTION

We have entered into a sales agreement with Cowen, under which we may offer and sell from time to time up to an aggregate of $50,000,000 of our common stock through Cowen as our sales agent. Sales of our common stock, if any, will be made at market prices by any method that is deemed to be an "at the market offering" as defined in Rule 415(a)(4) under the Securities Act, including sales made directly on or through The Nasdaq Global Market or on any other existing trading market for our common stock.

Cowen will offer our common stock subject to the terms and conditions of the sales agreement on a daily basis or as otherwise agreed upon by us and Cowen. We will designate the maximum amount of common stock to be sold through Cowen on a daily basis or otherwise determine such maximum amount together with Cowen. Subject to the terms and conditions of the sales agreement, Cowen will use its commercially reasonable efforts to sell on our behalf all of the shares of common stock requested to be sold by us. We may instruct Cowen not to sell common stock if the sales cannot be effected at or above the price designated by us in any such instruction. Cowen or we may suspend the offering of our common stock being made through Cowen under the sales agreement upon proper notice to the other party. Cowen and we each have the right, by giving written notice as specified in the sales agreement, to terminate the sales agreement in each party's sole discretion at any time.

The aggregate compensation payable to Cowen as sales agent equals 3.0% of the gross sales price of the shares sold through it pursuant to the sales agreement. We have also agreed to reimburse Cowen in a mutually agreed amount not to exceed $50,000 of Cowen's actual outside legal expenses incurred by Cowen in connection with this offering. We have also agreed to reimburse Cowen for its FINRA counsel fee of up to $15,000. We estimate that the total expenses of the offering payable by us, excluding commissions payable to Cowen under the sales agreement, will be approximately $210,000.

The remaining sales proceeds, after deducting any expenses payable by us and any transaction fees imposed by any governmental, regulatory, or self-regulatory organization in connection with the sales, will equal our net proceeds for the sale of such common stock.

Cowen will provide written confirmation to us following the close of trading on The Nasdaq Global Market on each day in which common stock is sold through it as sales agent under the sales agreement. Each confirmation will include the number of shares of common stock sold through it as sales agent on that day, the volume weighted average price of the shares sold, the percentage of the daily trading volume and the net proceeds to us.

In any quarter in which shares of common stock are sold through Cowen under the sales agreement, we will report the number of shares of common stock sold, the net proceeds to us and the compensation paid by us to Cowen in connection with the sales of common stock.

Settlement for sales of common stock will occur, unless the parties agree otherwise, on the second business day that is also a trading day following the date on which any sales were made in return for payment of the net proceeds to us. There is no arrangement for funds to be received in an escrow, trust or similar arrangement.

In connection with the sales of our common stock on our behalf, Cowen will be deemed to be an "underwriter" within the meaning of the Securities Act, and the compensation paid to Cowen will be deemed to be underwriting commissions or discounts. We have agreed in the sales agreement to provide indemnification and contribution to Cowen against certain liabilities, including liabilities under the Securities Act. As sales agent, Cowen will not engage in any transactions that stabilize our common stock.

Our common stock is listed on The Nasdaq Global Market and trades under the symbol "CATB." The transfer agent of our common stock is American Stock Transfer & Trust Company, LLC.

Cowen and its affiliates have provided, and may in the future provide, various investment banking and other financial services for us for which services they have received and, may in the future receive, customary fees.

LEGAL MATTERS

The validity of the shares of common stock offered hereby will be passed upon for us by Wilmer Cutler Pickering Hale and Dorr LLP, Boston, Massachusetts. Cowen and Company, LLC is being represented in connection with this offering by Cooley LLP, New York, New York.

EXPERTS

Ernst & Young, LLP, independent registered public accounting firm, has audited our consolidated financial statements included in our Annual Report on Form 10-K for the year ended December 31, 2018, as set forth in their report, which is incorporated by reference in this prospectus and elsewhere in the registration statement. Our financial statements are incorporated by reference in reliance on Ernst & Young LLP's report, given on their authority as experts in accounting and auditing.

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CATABASIS PHARMACEUTICALS, INC.

Up to $50,000,000

Common Stock

PROSPECTUS

Cowen

May 23, 2019