

PROSPECTUS



6,321,836 Shares

Common Stock Offered by the Selling Stockholders

This prospectus relates to the resale from time to time of up to 6,321,836 shares of common stock, par value \$0.001 per share, of X4 Pharmaceuticals, Inc. (the “Common Stock”) by the selling stockholders listed on page 7 (the “Selling Stockholders”), including their pledgees, assignees, donees, transferees or their respective successors-in-interest, which consist of 6,271,836 outstanding shares of our Common Stock held by the Selling Stockholders and 50,000 shares of our Common Stock issuable upon the exercise of outstanding pre-funded warrants to purchase shares of our Common Stock held by the Selling Stockholders. We will not receive any proceeds from the sale of the shares offered by this prospectus.

We have agreed, pursuant to a registration rights agreement that we have entered into with the Selling Stockholders, to bear all of the expenses incurred in connection with the registration of these shares. The Selling Stockholders will pay or assume discounts, commissions, fees of underwriters, selling brokers or dealer managers and similar expenses, if any, incurred for the sale of these shares of our Common Stock.

The Selling Stockholders identified in this prospectus, or their pledgees, assignees, donees, transferees or their respective successors-in-interest, may offer the shares from time to time on terms to be determined at the time of sale through ordinary brokerage transactions or through any other means described in this prospectus under the caption “Plan of Distribution.” The shares may be sold at fixed prices, at prevailing market prices, at prices related to prevailing market prices or at negotiated prices. For a list of the Selling Stockholders, see the section entitled “Selling Stockholders” on page 7.

We may amend or supplement this prospectus from time to time by filing amendments or supplements as required. You should read the entire prospectus and any amendments or supplements carefully before you make your investment decision.

Our Common Stock is traded on the Nasdaq Capital Market under the symbol “XFOR.” On July 8, 2021, the last reported sale price of our Common Stock was \$6.24 per share. You are urged to obtain current market quotations for our Common Stock.

We are an “emerging growth company” under applicable Securities and Exchange Commission rules and, as such, have elected to comply with certain reduced public company disclosure requirements for this prospectus and future filings. See “Prospectus Summary—Implications of Being an Emerging Growth Company.”

Investing in our Common Stock involves a high degree of risk. You should carefully read and consider the section entitled “[Risk Factors](#)” on page 5 and the risk factors included in our periodic reports filed with the Securities and Exchange Commission (“SEC”), in any applicable prospectus supplement and in any other documents we file with the SEC.

NEITHER THE SECURITIES AND EXCHANGE COMMISSION NOR ANY STATE SECURITIES COMMISSION HAS APPROVED OR DISAPPROVED OF THESE SECURITIES OR DETERMINED IF THIS PROSPECTUS IS TRUTHFUL OR COMPLETE. ANY REPRESENTATION TO THE CONTRARY IS A CRIMINAL OFFENSE.

The date of this prospectus is July 9, 2021.

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ABOUT THIS PROSPECTUS

We urge you to read carefully this prospectus, together with the information incorporated herein by reference as described under the heading “Where You Can Find Additional Information,” before buying any of the securities being offered.

You should rely only on the information contained or incorporated by reference in this prospectus and the applicable prospectus supplement or in any amendment to this prospectus. Neither we nor the Selling Stockholders have authorized anyone to provide you with different information, and if anyone provides, or has provided you, with different or inconsistent information, you should not rely on it. The Selling Stockholders are offering to sell, and seeking offers to buy, shares of our Common Stock, only in jurisdictions where offers and sales are permitted. The information contained in this prospectus, as well as the information filed previously with the SEC, and incorporated herein by reference, is accurate only as of the date of the document containing the information, regardless of the time of delivery of this prospectus or any applicable prospectus supplement or any sale of our Common Stock.

A prospectus supplement may add to, update or change the information contained in this prospectus. You should read both this prospectus and any applicable prospectus supplement together with additional information described below under the heading “Where You Can Find Additional Information.”

In this prospectus, references to “X4 Pharmaceuticals,” “X4,” the “Company,” the “registrant,” “we,” “us,” and “our” refer to X4 Pharmaceuticals, Inc., formerly Arsanis, Inc., and its subsidiaries. The phrase “this prospectus” refers to this prospectus and any applicable prospectus supplement, unless the context requires otherwise.

CAUTIONARY NOTE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus and any applicable prospectus supplement or free writing prospectus, including the documents incorporated by reference herein and therein, contain forward-looking statements. These are based on our management's current beliefs, expectations and assumptions about future events, conditions and results and on information currently available to us. Discussions containing these forward-looking statements may be found, among other places, in the sections entitled "Business," "Risk Factors" and "Management's Discussion and Analysis of Financial Condition and Results of Operations" contained in the documents incorporated by reference herein.

Any statements in this prospectus, or incorporated herein, about our expectations, beliefs, plans, objectives, assumptions or future events or performance are not historical facts and are forward-looking statements. Within the meaning of Section 27A of the Securities Act and Section 21E of the Securities Exchange Act of 1934, as amended ("the Exchange Act"), these forward-looking statements include statements regarding:

- our plans to develop and commercialize our product candidates;
- the timing of our planned clinical trials for our product candidates;
- the timing of and our ability to obtain and maintain regulatory approvals for our product candidates;
- the clinical utility of our product candidates;
- our commercialization, marketing and manufacturing capabilities and strategy;
- the impact of the COVID-19 pandemic on our business, operations, strategy, goals and anticipated timelines;
- our intellectual property position;
- our plans to in-license, acquire, develop and commercialize additional product candidates;
- our competitive position and the development of and projections relating to our competitors or our industry;
- our ability to identify, recruit and retain key personnel;
- the impact of laws and regulations;
- our plans to identify additional product candidates with significant commercial potential that are consistent with our commercial objectives;
- our estimates regarding future revenue, expenses and needs for additional financing; and
- other risks and uncertainties, including those listed under the caption "Risk Factors" in our most recent Annual Report on Form 10-K, our most recent Quarterly Report on Form 10-Q, and other filings we make with the SEC.

In some cases, you can identify forward-looking statements by terms such as "may," "will," "intend," "should," "could," "would," "expect," "plan," "anticipate," "believe," "estimate," "project," "predict," "potential," "continue," "likely," and similar expressions (including their use in the negative) intended to identify forward-looking statements. These forward-looking statements reflect our current views with respect to future events and are based on assumptions and subject to risks and uncertainties. Given these risks and uncertainties, you should not place undue reliance on these forward-looking statements. We discuss many of these risks in greater detail under the heading "Risk Factors" in our SEC filings, and may provide additional information in any applicable prospectus supplement. Also, these forward-looking statements represent our estimates and assumptions only as of the date of the document containing the applicable statement.

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We qualify all of the forward-looking statements in the foregoing documents by these cautionary statements. Unless required by law, we undertake no obligation to update or revise any forward-looking statements to reflect new information or future events or developments. Thus, you should not assume that our silence over time means that actual events are bearing out as expressed or implied in such forward-looking statements. Before deciding to purchase our Common Stock, you should carefully consider the risk factors incorporated by reference herein, in addition to the other information set forth in this prospectus and in the documents incorporated by reference herein.

PROSPECTUS SUMMARY

This summary highlights important features of this offering and the information included or incorporated by reference in this prospectus. This summary does not contain all of the information you should consider before investing in our Common Stock. You should carefully read this prospectus, any applicable prospectus supplement and the information incorporated by reference in this prospectus and any applicable prospectus supplement before you invest in our Common Stock.

Company Overview

We are a late-stage clinical biopharmaceutical company focused on the research, development and commercialization of novel therapeutics for the treatment of rare diseases. Our pipeline is comprised of potentially first-in-class, oral, small molecule antagonists of chemokine receptor CXCR4, which have the potential to treat a broad range of rare diseases, including primary immunodeficiencies and certain types of cancer. Our lead product candidate, mavorixafor, is a potentially first-in-class, oral, allosteric antagonist of the CXCR4 receptor designed to correct the abnormal signaling caused by the receptor/ligand interaction and enable mobilization and trafficking of immune cells.

We have completed the dose-titration portion of the Phase 2 clinical trial of mavorixafor in patients with Warts, Hypogammaglobulinemia, Infections, and Myelokathexis (“WHIM”) syndrome, which is a rare, inherited primary immunodeficiency disease. In June 2019, we initiated 4WHIM, a pivotal, 52-week Phase 3 global clinical trial of mavorixafor for the treatment of patients with WHIM syndrome. The U.S. Food and Drug Administration (“FDA”) has granted Breakthrough Therapy Designation for mavorixafor for the treatment of adults with WHIM. The FDA has also granted Fast Track Designation for mavorixafor for adults with WHIM and Rare Pediatric Designation for mavorixafor for the treatment of WHIM. In November 2019, we initiated a 14-day, proof-of-concept Phase 1b clinical trial of mavorixafor in patients with severe congenital neutropenia, and in December 2019, we initiated a Phase 1b clinical trial of mavorixafor, in combination with ibrutinib, in patients with Waldenström’s macroglobulinemia. We are also investigating mavorixafor in combination with axitinib (Inlyta®) in the Phase 2a portion of an open-label Phase 1/2 clinical trial in clear cell renal cell carcinoma.

We are also advancing two early stage candidates towards the clinic: X4P-003, a second-generation CXCR4 antagonist designed to have an enhanced pharmacokinetic and potency profile relative to mavorixafor, potentially enabling broader opportunities in CXCR4-dependent disorders; and X4P-002, a CXCR4 antagonist designed to cross blood-brain barrier and provide appropriate therapeutic exposures to treat brain cancers and other diseases where exposure in-brain is essential.

To date, we have not generated revenue from product sales and do not expect to generate significant revenue from the sale of our products in the foreseeable future. If our development efforts for our product candidates are successful and result in regulatory approval, we may generate revenue in the future from product sales. We cannot predict if, when, or to what extent we will generate revenue from the commercialization and sale of our product candidates. We may never succeed in obtaining regulatory approval for any of our product candidates.

Private Placement

Securities Purchase Agreement

On March 18, 2021, we entered into a Securities Purchase Agreement (the “Purchase Agreement”) with the purchasers named therein (the “Purchasers”), pursuant to which we agreed to sell and issue an aggregate

of (i) 6,271,836 shares of Common Stock at a purchase price of \$8.70 per share, and (ii) to certain investors pre-funded warrants to purchase an aggregate of 50,000 shares of Common Stock at a price of \$0.01 per share, at a purchase price of \$8.69 per pre-funded warrant (the "Private Placement"). On March 23, 2021, we closed the Private Placement and issued an aggregate of 6,271,836 shares of Common Stock and 50,000 pre-funded warrants to purchase Common Stock to the Purchasers.

The pre-funded warrants are exercisable at any time after their original issuance and will not expire. The pre-funded warrants provide that a holder of such pre-funded warrants will not have the right to exercise any portion of its pre-funded warrants if such holder, together with its affiliates, would beneficially own in excess of 9.99% of the number of shares of our Common Stock outstanding immediately after giving effect to such exercise (the "Beneficial Ownership Limitation"); provided, however, that each holder may increase or decrease the Beneficial Ownership Limitation by giving 61 days' notice to us, but not to any percentage in excess of 19.99%.

The shares of Common Stock issued to the Purchasers, and the shares of Common Stock issuable upon exercise of the pre-funded warrants, were not initially registered under the Securities Act or any state securities laws. We have relied on the exemption from the registration requirements of the Securities Act by virtue of Section 4(a)(2) thereof. In connection with their execution of the Purchase Agreement, each of the Purchasers represented to us that such Purchaser is an "accredited investor" as defined in Regulation D of the Securities Act and that the shares of Common Stock purchased by such Purchaser were being acquired solely for its own account and for investment purposes and not with a view to its future sale or distribution.

Registration Rights Agreement

On March 18, 2021, in connection with the Financing, we entered into a Registration Rights Agreement with the Purchasers (the "Registration Rights Agreement"), pursuant to which we agreed to (i) by no later than June 30, 2021, file a registration statement with the SEC to cover the resale of the shares of Common Stock, including those shares of Common Stock issuable upon exercise of the pre-funded warrants to purchase Common Stock, issued to the Purchasers pursuant to the Purchase Agreement (the "Shares"), (ii) to use commercially reasonable efforts to cause such registration statement to become effective as soon as practicable and (iii) to keep such registration statement effective until the date the Shares covered by such registration statement have been sold or may be resold pursuant to Rule 144 without restriction. In the event that such registration statement is not filed or declared effective within the timeframes set forth in the Registration Rights Agreement or, after the registration statement has been declared effective by the SEC, sales cannot be made pursuant to the registration statement for any reason including by reason of a stop order or our failure to update such registration statement, subject to certain limited exceptions, then we have agreed to make pro rata payments to each Purchaser as liquidated damages in an amount equal to 1% of the aggregate amount invested by each such Investor in the Shares per 30-day period or pro rata for any portion thereof for each such month during which such event continues, subject to certain caps set forth in the registration rights agreement.

The registration statement of which this prospectus is a part relates to the offer and resale of the Shares issued to the Purchasers pursuant to the Purchase Agreement. When we refer to the Selling Stockholder in this prospectus, we are referring to the Purchasers named in this prospectus as the Selling Stockholders and, as applicable, any donees, pledgees, assignees, transferees or other successors-in-interest selling Shares received after the date of this prospectus from the Selling Stockholders as a gift, pledge, or other non-sale related transfer.

Corporate Information

Prior to March 13, 2019, we were a clinical-stage biopharmaceutical company known as Arsanis, Inc. that had historically been focused on applying monoclonal antibody immunotherapies to address serious infectious diseases. Arsanis, Inc. was originally incorporated in the State of Delaware in August 2010.

On March 13, 2019, we completed our business combination with X4 Therapeutics, Inc. (formerly X4 Pharmaceuticals, Inc.) in accordance with the terms of an Agreement and Plan of Merger, dated as of November 26, 2018, as amended on December 20, 2018 and March 8, 2019 (the “Merger Agreement”), that we entered into with X4 Therapeutics, Inc. and Artemis AC Corp., a Delaware corporation and our wholly owned subsidiary (“Merger Sub”). Pursuant to the terms of the Merger Agreement, Merger Sub merged with and into X4 Therapeutics, Inc., with X4 Therapeutics, Inc. continuing as our wholly owned subsidiary and the surviving corporation of the merger, which transaction we refer to as the Merger. At the closing of the Merger, we issued shares of our Common Stock to X4 Therapeutics, Inc. stockholders based on an agreed upon exchange ratio, and each option or warrant to purchase X4 Therapeutics, Inc. capital stock became an option or warrant, respectively, to purchase our Common Stock, subject to adjustment in accordance with the agreed upon exchange ratio. Following the closing of the Merger, we effected a 1-for-6 reverse stock split of our Common Stock, our name was changed to X4 Pharmaceuticals, Inc., the business of X4 Therapeutics, Inc. became our business, and we became a clinical-stage biopharmaceutical company focused on the discovery, development and commercialization of novel therapeutics for the treatment of rare diseases. In connection with the closing of the Merger, our stock began trading on the Nasdaq Capital Market under the symbol “XFOR” on March 14, 2019.

Our principal executive offices are located at 61 North Beacon Street, 4th Floor, Boston, Massachusetts 02134, and our telephone number is (857) 529-8300. Our website is located at <http://www.x4pharma.com>. We do not incorporate by reference into this prospectus the information on, or accessible through, our website, and you should not consider it as part of this prospectus.

THE OFFERING

Common Stock Offered by the Selling Stockholders	6,321,836 Shares
Use of Proceeds	We will not receive any proceeds from the sale of the Shares covered by this prospectus.
Nasdaq Capital Market Symbol	XFOR

RISK FACTORS

An investment in our Common Stock involves a high degree of risk. Prior to making a decision about investing in our Common Stock, you should consider carefully the specific risk factors discussed in the sections entitled “Risk Factors” contained in our most recent Quarterly on Form 10-Q for the quarter ended March 31, 2021, as filed with the SEC on May 6, 2021, which are incorporated in this prospectus by reference in their entirety, as well as any amendment or updates to our risk factors reflected in subsequent filings with the SEC, including any prospectus supplement hereto. These risks and uncertainties are not the only risks and uncertainties we face. Additional risks and uncertainties not presently known to us, or that we currently view as immaterial, may also impair our business. If any of the risks or uncertainties described in our SEC filings or any additional risks and uncertainties actually occur, our business, financial condition, results of operations and cash flow could be materially and adversely affected. In that case, the trading price of our Common Stock could decline and you might lose all or part of your investment.

USE OF PROCEEDS

We are filing the registration statement of which this prospectus forms a part to permit the holders of the Shares of our Common Stock described in the section entitled “Selling Stockholders” to resell such Shares. We are not selling any securities under this prospectus, and we will not receive any proceeds from the sale or other disposition of shares of our Common Stock held by the Selling Stockholders.

The Selling Stockholders will pay any underwriting discounts and commissions and expenses incurred by the Selling Stockholders for brokerage, accounting, tax or legal services or any other expenses incurred by the Selling Stockholders in disposing of these Shares. We will bear all other costs, fees and expenses incurred in effecting the registration of the Shares covered by this prospectus, including, without limitation, all registration and filing fees, Nasdaq listing fees and fees and expenses of our counsel and our accountants.

SELLING STOCKHOLDERS

This prospectus covers the sale or other disposition by the Selling Stockholders of up to the total number of shares of our Common Stock that were issued to the Purchasers pursuant to the Purchase Agreement, plus the total number of shares of our Common Stock issuable upon exercise of the pre-funded warrants issued to the Selling Stockholders, without giving effect to the Beneficial Ownership Limitation described under “Prospectus Summary—Private Placement—Securities Purchase Agreement.” The table below sets forth, to our knowledge, information concerning the beneficial ownership of shares of our Common Stock by the Selling Stockholders as of June 23, 2021. The information in the table below with respect to the selling stockholders has been obtained from the respective Selling Stockholders. When we refer to the “Selling Stockholders” in this prospectus, or, if required, a post-effective amendment to the registration statement of which this prospectus is a part, we mean the Selling Stockholders listed in the table below as offering shares, as well as their respective pledgees, assignees, donees, transferees or successors-in-interest. Throughout this prospectus, when we refer to the shares of our Common Stock being registered on behalf of the Selling Stockholders, we are referring to the shares of our Common Stock and the shares underlying the pre-funded warrants issued to the Selling Stockholders pursuant to the Purchase Agreement, without giving effect to the Beneficial Ownership Limitation described above. The Selling Stockholders may sell all, some or none of the shares of Common Stock subject to this prospectus. See “Plan of Distribution” below as it may be supplemented and amended from time to time.

The number of shares of Common Stock beneficially owned prior to the offering for each Selling Stockholder includes all shares of our Common Stock beneficially held by such Selling Stockholder as of June 23, 2021, which includes (i) all shares of our Common Stock purchased by such Selling Stockholder in the Private Placement and (ii) all shares of Common Stock issuable upon exercise of the pre-funded warrants purchased by such Selling Stockholder in the Private Placement. The percentages of shares owned before and after the offering are based on 24,766,615 shares of Common Stock outstanding as of June 23, 2021, which includes the outstanding shares of Common Stock offered by this prospectus but does not include any shares of Common Stock offered by this prospectus that are issuable pursuant to warrants or pre-funded warrants and are deemed outstanding in the table below because they are beneficially owned by a person.

Beneficial ownership is determined in accordance with the rules of the SEC and includes voting or investment power with respect to our Common Stock. Generally, a person “beneficially owns” shares of our Common Stock if the person has or shares with others the right to vote those shares or to dispose of them, or if the person has the right to acquire voting or disposition rights within 60 days. In computing the number of shares of our Common Stock beneficially owned by a person and the percentage ownership of that person, we deemed outstanding shares of Common Stock issuable upon the exercise of pre-funded warrants or warrants held by that Selling Stockholder that are exercisable within 60 days of June 23, 2021. We did not deem these shares outstanding, however, for the purpose of computing the percentage ownership of any other person. The inclusion of any shares in this table does not constitute an admission of beneficial ownership for any selling stockholder named below.

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Name of Selling Stockholder	Shares of Common Stock Beneficially Owned Prior to Offering		Number of Shares of Common Stock Being Offered(1)	Shares of Common Stock to be Beneficially Owned After Offering(2)	
	Number	Percentage		Number	Percentage
Entities affiliated with Ikarian Healthcare Master Fund, LP (3)	2,739,882	11.06%	1,379,310	1,360,572	5.49%
Entities affiliated with Bain Capital Life Sciences (4)	2,576,472	9.99%	919,540	2,672,980	9.99%
OrbiMed Private Investments IV, LP (5)	1,836,349	7.28%	287,356	1,548,993	6.14%
Altium Growth Fund, LP (6)	804,598	3.25%	804,598	—	—
Entities affiliated with Sio Capital Management, LLC (7)	804,597	3.25%	804,597	—	—
Driehaus Life Sciences Master Fund, L.P. (8)	800,120	3.23%	574,712	225,408	*
Entities affiliated with Monashee Investment Management LLC (9)	574,712	2.32%	574,712	—	—
Lytton-Kambara Foundation (10)	426,731	1.72%	229,885	196,846	*
Hercules Capital, Inc. (11)	306,581	1.23%	114,943	191,638	*
Lincoln Park Capital Fund, LLC (12)	236,085	*	229,885	6,200	*
Abingworth Bioventures 8 LP (13)	229,885	*	229,885	—	—
Hudson Bay Master Fund Ltd. (14)	172,413	*	172,413	—	—

* Less than one percent.

- (1) The number of shares of our Common Stock in the column “Number of Shares of Common Stock Being Offered” represents all of the shares of our Common Stock that a Selling Stockholder may offer and sell from time to time under this prospectus.
- (2) We do not know when or in what amounts a Selling Stockholder may offer shares for sale. The Selling Stockholders might not sell all or might sell all of the shares offered by this prospectus. Because the Selling Stockholders may offer all or some of the shares pursuant to this offering, and because there are currently no agreements, arrangements or understandings with respect to the sale of any of the shares, we cannot estimate the number of the shares that will be held by the Selling Stockholders after completion of the offering. However, for purposes of this table, we have assumed that, after completion of the offering, none of the shares covered by this prospectus will be held by the Selling Stockholders, including Common Stock issuable upon exercise of the pre-funded warrants issued in the Private Placement.
- (3) Consists of (i) the following shares of Common Stock purchased in the Private Placement: (a) 1,204,226 shares held by Ikarian Healthcare Master Fund, LP (the “Ikarian Fund”), (b) 105,821 shares of Common Stock held by Boothbay Absolute Return Strategies, LP (“BBARS”) and (c) 69,263 shares of Common Stock held by Boothbay Diversified Alpha Master Fund, LP (“BBDAMF”), and (ii) 1,360,572 additional shares of Common Stock held of record by the Ikarian Fund and the Ikarian Managed Accounts (as defined below). Ikarian Capital, LLC (“Ikarian Capital”) is the investment manager of, and may be deemed to indirectly beneficially own securities owned by, the Ikarian Fund. Ikarian Healthcare Fund GP, L.P., (“Ikarian GP”) is the general partner of, and may be deemed to indirectly beneficially own securities owned by, the Ikarian Fund. Ikarian Capital is also the general partner of, and may be deemed to indirectly beneficially own, securities beneficially owned by Ikarian GP. Ikarian Capital is a sub-advisor for certain separate managed accounts, including BBARS and BBDAMF, (collectively, the “Ikarian Managed Accounts”) and may be deemed to indirectly beneficially own securities owned by the Ikarian Managed Accounts. Ikarian Capital is ultimately owned and controlled by Chart Westcott Living Trust, of which Chart Westcott serves as the sole trustee (the “Westcott Trust”), and indirectly by Neil Shahrestani. Accordingly, each of Mr. Westcott, as sole trustee of the Westcott Trust, and Mr. Shahrestani may be deemed to indirectly beneficially own securities beneficially owned by Ikarian Capital. The Ikarian Fund disclaims beneficial ownership of the shares held by the Ikarian Managed Accounts. Each of BBARS and

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BBDAMF is managed by Boothbay Fund Management, LLC, (“Boothbay”). Boothbay, in its capacity as the investment manager of BBARS and BBDAMF, has the power to vote and the power to direct the disposition of all securities held by BBARS and BBDAMF. Ari Glass is the managing member of Boothbay. Each of BBARS, BBDAMF, Boothbay and Mr. Glass disclaim beneficial ownership of the shares held by BBARS and BBDAMF, except to the extent of any pecuniary interest therein. The address for each of BBARS, BBDAMF, Boothbay and Mr. Glass is c/o Boothbay Fund Management, LLC, 140 E. 45th Street, 14th Floor, New York, NY 10017. The address for the Ikarian Fund, Ikarian Capital, Ikarian GP, the Westcott Trust, Mr. Westcott and Mr. Shahrestani is 100 Crescent Court, Suite 1620, Dallas, TX 75201.

- (4) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) the following shares of Common Stock purchased in the Private Placement: (a) 775,133 shares of Common Stock and 44,571 shares of Common Stock issuable upon exercise of pre-funded warrants, in each case held by Bain Capital Life Sciences Fund II, L.P. (“BCLS II”) and (b) 94,407 shares of Common Stock and 5,429 shares of Common Stock issuable upon exercise of pre-funded warrants, in each case held by BCIP Life Sciences Associates, LP (“BCIPLS” and, together with BCLS II, the “Bain Capital Life Science Entities”), (ii) 557,143 additional shares of Common Stock held by BCLS II, (iii) 125,891 additional shares of Common Stock held by BCIPLS, (iv) additional pre-funded warrants to purchase an aggregate of 557,143 shares of Common Stock held by BCLS II, (v) additional pre-funded warrants to purchase an aggregate of 125,891 shares of Common Stock held by BCIPLS, (vi) Class B warrants to purchase an aggregate of 39,082 shares of Common Stock held by BCLS II and (vii) Class B warrants to purchase an aggregate of 251,782 shares of Common Stock held by BCIPLS. In addition to the foregoing shares, as of June 23, 2021, BCLS II held Class B warrants to purchase an aggregate of 1,075,203 additional shares of Common Stock that are not included in the shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” because they are subject to limitations on exercisability if such exercise would result in the Bain Capital Life Science Entities beneficially owning more than 9.99% of our outstanding Common Stock. The shares reported under “Number of Shares of Common Stock Being Offered” consist of the shares of Common Stock, including the shares of Common Stock issuable upon exercise of pre-funded warrants, purchased by the Bain Capital Life Science Entities in the Private Placement and included under “Shares of Common Stock Beneficially Owned Prior to the Offering,” without giving effect to the Beneficial Ownership Limitation. The shares reported under “Shares of Common Stock Beneficially Owned After to the Offering” includes an aggregate of 1,016,048 additional shares of Common Stock issuable upon exercise of Class B warrants held by BCLS II that would be exercisable following the disposition by the Bain Capital Life Science Entities of all of the shares registered for sale under this prospectus. Bain Capital Life Sciences Investors, LLC (“BCLSI”), whose managers are Jeffrey Schwartz and Adam Koppel, is the ultimate general partner of BCLS II and governs the investment strategy and decision-making process with respect to investments held by BCIPLS. As a result, each of BCLSI, Mr. Schwartz and Dr. Koppel may be deemed to share voting and dispositive power with respect to the shares of Common Stock held by the Bain Capital Life Sciences Entities. The address of the Bain Capital Life Sciences Entities is c/o Bain Capital Life Sciences, LP, 200 Clarendon Street, Boston, MA 02116.
- (5) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) 287,356 shares of Common Stock purchased in the Private Placement, (ii) 1,086,493 additional shares of Common Stock held by OrbiMed Private Investments IV, LP (“OPI IV”), and (iii) warrants to purchase an aggregate of 462,500 shares of Common Stock held by OPI IV. OrbiMed Capital GP IV LLC (“GP IV”) is the general partner of OPI IV. OrbiMed Advisors LLC (“OrbiMed Advisors”) is the managing member of GP IV. By virtue of such relationships, GP IV and OrbiMedAdvisors may be deemed to have voting and investment power with respect to the shares held by OPI IV and as a result may be deemed to have beneficial ownership of such shares. OrbiMed Advisors exercises investment and voting power through a management committee comprised of Carl L. Gordon, Sven H. Borho and Jonathan T. Silverstein. Each of GP IV and OrbiMedAdvisors disclaims beneficial ownership of the shares held by OPI IV, except to the extent of its or his pecuniary interest therein if any. The address for each of OPI IV, GP IV, OrbiMed Advisors and Messrs. Gordon, Borho and Silverstein is c/o OrbiMed Private Investments IV, LP, 601 Lexington Avenue, 54th Floor, New York, NY 10022.

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- (6) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of shares purchased in the Private Placement. The address of Altium Growth Fund, LP is 152 W. 57th St., Floor 20, New York, NY 10019.
- (7) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of the following shares of Common Stock purchased in the Private Placement: (i) 253,006 shares of Common Stock held by Sio Partners LP (“Partners”), (ii) 136,130 shares of Common Stock held by Sio Partners Offshore LTD (“Offshore”), (iii) 163,591 shares of Common Stock held by Compass MAV LLC (“Compass”), (iv) 104,582 shares of Common Stock held by Compass Offshore MAV LTD (“Compass Offshore”), (v) 58,074 shares of Common Stock held by Walleye Trading LLC (“Walleye Trading”) and (vi) 89,214 shares of Common Stock held by Walleye Opportunities Master Fund Ltd. (Walleye Master”). Sio Capital Management, LLC (“Sio Management”) is the investment manager of Partners, Offshore, Compass, Compass Offshore, Walleye Trading and Walleye Master, and Michael Castor is the sole owner and Managing Member of Sio Management. Sio Management and Mr. Castor may be deemed to beneficially own the securities held by Partners, Offshore, Compass, Compass Offshore, Walleye Trading, and Walleye Master. Each of Sio Management and Mr. Castor disclaim beneficial ownership of any of the shares of our Common Stock they may be deemed to beneficially own except to the extent of their respective pecuniary interest therein. The address for Sio Management, Mr. Castor, Partners, Offshore, Compass, Compass Offshore, Walleye Trading and Walleye Master is 600 Third Avenue, 2nd Floor, New York, New York 10016.
- (8) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) 574,712 shares of Common Stock purchased in the Private Placement, (ii) 220,600 additional shares of Common Stock, and (iii) warrants to purchase an aggregate of 4,808 shares of Common Stock. The address of Driehaus Life Sciences Master Fund, L.P. is 25 E. Erie St., Chicago, IL 60611.
- (9) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of the following shares of Common Stock purchased in the Private Placement: (i) 117,471 shares of Common Stock held by Monashee Solitario Fund LP, (ii) 170,115 shares of Common Stock held by DS Liquid DIV RVA MON LLC, (iii) 22,011 shares of Common Stock held by Bespoke Alpha MAC MIM LP, (iv) 25,690 shares of Common Stock held by SFL SPV I LLC, (v) 93,448 shares of Common Stock held by Monashee Pure Alpha SPV I LP and (vi) 145,977 shares of Common Stock held by BEMAP Master Fund Ltd. The address for these affiliated holders is c/o Monashee Investment Management LLC, 75 Park Plaza, 2nd Floor, Boston, MA 02116
- (10) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) 229,885 shares of Common Stock purchased in the Private Placement and (ii) 196,846 additional shares of Common Stock. Laurence Lytton has voting and investment control over the shares of Common Stock held by the Lytton-Kambara Foundation. The address of the Lytton-Kambara Foundation is c/o Laurence Lytton, 467 Central Park West, 17A, New York, NY 10025.
- (11) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) 114,943 shares of Common Stock purchased in the Private Placement, (ii) 83,334 additional shares of Common Stock, and (iii) warrants to purchase an aggregate of 108,334 shares of Common Stock. The address of Hercules Capital, Inc. is 400 Hamilton Avenue, Suite 310, Palo Alto, CA 94301.
- (12) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of (i) 229,885 shares of Common Stock purchased in the Private Placement, (ii) 3,200 additional shares of Common Stock, and (iii) warrants to purchase an aggregate of 3,000 shares of Common Stock. Joshua Scheinfeld and Jonathan Cope, the principals of Lincoln Park Capital Fund, LLC are deemed to be beneficial owners of all of the Common Stock owned by Lincoln Park Capital Fund, LLC, and Messrs. Scheinfeld and Cope have shared disposition power over the shares of Common Stock. The address of Lincoln Park Capital Fund, LLC is 440 N. Wells St., Suite 410, Chicago, IL 60654.
- (13) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of shares purchased in the Private Placement. Abingworth Bioventures 8 GP LP (“Abingworth GP”) serves as the general partner of Abingworth Bioventures 8 LP (“ABV 8”). Abingworth General Partner 8 LLP, serves as the general partner of Abingworth GP. ABV 8 (acting by its general partner Abingworth GP, acting by its general partner Abingworth General Partner 8 LLP) has delegated to Abingworth LLP, all voting,

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investment and dispositive power over the securities held by ABV 8. Abingworth LLP has an investment committee which approves investment and voting decisions for ABV 8 by a defined majority vote, and no individual member has the sole control or voting power over the shares held by ABV 8. Each of Abingworth GP, Abingworth GP 8, and each member of the investment committee disclaims beneficial ownership of the shares held by ABV 8 except to the extent of their pecuniary interest therein. The address for ABV8, Abingworth GP, Abingworth General Partner 8 LLP and Abingworth LLP is c/o Abingworth LLP, 38 Jermyn Street, London SW1Y 6 DN, United Kingdom.

- (14) The shares reported under “Shares of Common Stock Beneficially Owned Prior to the Offering” consists of 172,413 shares of Common Stock purchased in the Private Placement. Hudson Bay Capital Management LP, the investment manager of Hudson Bay Master Fund Ltd., has voting and investment power over these securities. Sander Gerber is the managing member of Hudson Bay Capital GP LLC, which is the general partner of Hudson Bay Capital Management LP. Each of Hudson Bay Master Fund Ltd. and Sander Gerber disclaims beneficial ownership over these securities. The address of each of Hudson Bay Master Fund Ltd., Hudson Bay Capital Management LP, Hudson Bay Capital GP LLC and Sander Gerber is c/o Hudson Bay Capital Management LP, 777 Third Avenue, 30th Floor, New York, NY 10017.

Relationships with Selling Stockholders

As discussed in greater detail above under the section titled “*Prospectus Summary—Private Placement*” in March 2021, we entered into the Purchase Agreement with the Selling Stockholders, pursuant to which we sold and issued shares of our Common Stock and pre-funded warrants to purchase our Common Stock, and we also entered into the Registration Rights Agreement with the Selling Stockholders, pursuant to which we agreed to file a registration statement with the SEC to cover the resale by the Selling Stockholders of the shares of our Common Stock, including shares of Common stock issuable upon exercise of the pre-funded warrants, issued pursuant to the Purchase Agreement by the Selling stockholder.

We are also party to an Amended and Restated Loan and Security Agreement, as amended, with Hercules. We are also party to an Option Agreement, as amended, with ABV 8, which Option Agreement provides ABV8 with a right to require us to repurchase the Shares of our Common Stock that ABV 8 purchased from us in the Private Placement (the “Abingworth Shares”). Pursuant to the Option Agreement, as amended, if we and a syndicate, of which an entity affiliated with ABV 8 is a part, do not execute a definitive co-development agreement by July 15, 2021, ABV 8 may, at its option, require us to repurchase the Abingworth Shares at the original purchase price of \$8.70 per share. This option must be exercised, if at all, by August 15, 2021. Other than these relationships with Hercules and Abingworth, none of the Selling Stockholders has had a material relationship with us or any of our predecessors or affiliates within the past three years, other than as a result of the ownership of our shares of Common Stock or other securities.

None of the Selling Stockholders has held any position or office with us or our affiliates within the last three years. Carl Gordon, who serves on the investment committee of OrbiMed Advisors, served on the Board of Directors of Arsanis, Inc., our predecessor, from 2010 to March 13, 2019.

PLAN OF DISTRIBUTION

The Selling Stockholders, which as used herein includes donees, pledgees, transferees or other successors-in-interest selling shares of Common Stock or interests in shares of Common Stock received after the date of this prospectus from a Selling Stockholder as a gift, pledge, partnership distribution or other transfer, may, from time to time, sell, transfer or otherwise dispose of any or all of their shares of Common Stock or interests in shares of Common Stock on any stock exchange, market or trading facility on which the shares are traded or in private transactions. These dispositions may be at fixed prices, at prevailing market prices at the time of sale, at prices related to the prevailing market price, at varying prices determined at the time of sale, or at negotiated prices.

The Selling Stockholders may use any one or more of the following methods when disposing of shares or interests therein:

- ordinary brokerage transactions and transactions in which the broker-dealer solicits purchasers;
- block trades in which the broker-dealer will attempt to sell the shares as agent, but may position and resell a portion of the block as principal to facilitate the transaction;
- purchases by a broker-dealer as principal and resale by the broker-dealer for its account;
- an exchange distribution in accordance with the rules of the applicable exchange;
- privately negotiated transactions;
- short sales effected after the date the registration statement of which this prospectus is a part is declared effective by the SEC;
- through the writing or settlement of options or other hedging transactions, whether through an options exchange or otherwise;
- broker-dealers may agree with the Selling Stockholders to sell a specified number of such shares at a stipulated price per share;
- a combination of any such methods of sale; and
- any other method permitted by applicable law.

The Selling Stockholders may, from time to time, pledge or grant a security interest in some or all of the shares of Common Stock owned by them and, if they default in the performance of their secured obligations, the pledgees or secured parties may offer and sell the shares of Common Stock, from time to time, under this prospectus, or under an amendment to this prospectus under Rule 424(b)(3) or other applicable provision of the Securities Act of 1933, as amended (the "Securities Act"), amending the list of Selling Stockholders to include the pledgee, transferee or other successors in interest as Selling Stockholders under this prospectus. The Selling Stockholders also may transfer the shares of Common Stock in other circumstances, in which case the transferees, pledgees, donees or other successors in interest will be the selling beneficial owners for purposes of this prospectus.

In connection with the sale of our Common Stock or interests therein, the Selling Stockholders may enter into hedging transactions with broker-dealers or other financial institutions, which may in turn engage in short sales of the Common Stock in the course of hedging the positions they assume. The Selling Stockholders may also sell shares of our Common Stock short and deliver these securities to close out their short positions, or loan or pledge the Common Stock to broker-dealers that in turn may sell these securities. The Selling Stockholders may also enter into option or other transactions with broker-dealers or other financial institutions or the creation of one or more derivative securities which require the delivery to such broker-dealer or other financial institution of shares offered by this prospectus, which shares such broker-dealer or other financial institution may resell pursuant to this prospectus (as supplemented or amended to reflect such transaction).

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The aggregate proceeds to the Selling Stockholders from the sale of the Common Stock offered by them will be the purchase price of the Common Stock less discounts or commissions, if any. Each of the Selling Stockholders reserves the right to accept and, together with their agents from time to time, to reject, in whole or in part, any proposed purchase of Common Stock to be made directly or through agents. We will not receive any of the proceeds from this offering. Upon any exercise of the pre-funded warrants by payment of cash, however, we will receive the exercise price of \$0.01 per share pursuant to the pre-funded warrants.

The Selling Stockholders also may resell all or a portion of the shares in open market transactions in reliance upon Rule 144 under the Securities Act of 1933, provided that they meet the criteria and conform to the requirements of that rule. The Selling Stockholders and any underwriters, broker-dealers or agents that participate in the sale of the Common Stock or interests therein may be “underwriters” within the meaning of Section 2(11) of the Securities Act. Any discounts, commissions, concessions or profit they earn on any resale of the shares may be underwriting discounts and commissions under the Securities Act. Selling Stockholders who are “underwriters” within the meaning of Section 2(11) of the Securities Act will be subject to the prospectus delivery requirements of the Securities Act.

To the extent required, the shares of our Common Stock to be sold, the names of the Selling Stockholders, the respective purchase prices and public offering prices, the names of any agents, dealer or underwriter, and any applicable commissions or discounts with respect to a particular offer will be set forth in an accompanying prospectus supplement or, if appropriate, a post-effective amendment to the registration statement that includes this prospectus.

In order to comply with the securities laws of some states, if applicable, the Common Stock may be sold in these jurisdictions only through registered or licensed brokers or dealers. In addition, in some states the Common Stock may not be sold unless it has been registered or qualified for sale or an exemption from registration or qualification requirements is available and is complied with.

We have advised the Selling Stockholders that the anti-manipulation rules of Regulation M under the Securities Exchange Act of 1934, as amended, may apply to sales of shares in the market and to the activities of the Selling Stockholders and their affiliates. In addition, to the extent applicable, we will make copies of this prospectus (as it may be supplemented or amended from time to time) available to the Selling Stockholders for the purpose of satisfying the prospectus delivery requirements of the Securities Act. The Selling Stockholders may indemnify any broker-dealer that participates in transactions involving the sale of the shares against certain liabilities, including liabilities arising under the Securities Act.

We have agreed to indemnify the Selling Stockholders against liabilities, including liabilities under the Securities Act and state securities laws, relating to the registration of the shares offered by this prospectus.

We have agreed with the Selling Stockholders to use commercially reasonable efforts to cause the registration statement of which this prospectus constitutes a part effective and to remain continuously effective until the earlier of (1) such time as all of the shares covered by this prospectus have been disposed of pursuant to and in accordance with such registration statement or (2) the date on which all of the shares may be sold without restriction pursuant to Rule 144 of the Securities Act.

LEGAL MATTERS

The validity of the Shares to be offered for resale by the Selling Stockholders under this prospectus will be passed upon for us by Cooley LLP, New York, New York.

EXPERTS

The financial statements incorporated in this prospectus by reference to the Annual Report on Form 10-K for the year ended December 31, 2020 have been so incorporated in reliance on the report (which contains an explanatory paragraph relating to our ability to continue as a going concern as described in Note 1 to the financial statements) of PricewaterhouseCoopers LLP, an independent registered public accounting firm, given on the authority of said firm as experts in auditing and accounting.

WHERE YOU CAN FIND MORE INFORMATION

This prospectus is part of a registration statement that 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 subsidiaries and our securities. 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. You can obtain a copy of the registration statement from the SEC's website.

We file annual, quarterly and current reports, proxy statements and other information with the SEC. Our SEC filings are available to the public over the Internet at the SEC's website at <http://www.sec.gov>.

We make available, free of charge, through our investor relations website, our Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, statements of changes in beneficial ownership of securities and amendments to those reports and statements as soon as reasonably practicable after they are filed with the SEC. The address for our website is www.x4pharma.com. Information contained in or accessible through our website does not constitute a part of this prospectus and is not incorporated by reference in this prospectus.

INCORPORATION OF CERTAIN INFORMATION BY REFERENCE

The SEC allows us to “incorporate by reference” information into this prospectus, which means that we can disclose important information to you by referring you to another document filed separately with the SEC. The SEC file number for the documents incorporated by reference in this prospectus is 001-38295. The documents incorporated by reference into this prospectus contain important information that you should read about us.

The following documents are incorporated by reference into this document:

- Our Annual Report on [Form 10-K](#) for the fiscal year ended December 31, 2020 (the “2020 Annual Report”), filed with the SEC on March 19, 2021, including the information specifically incorporated by reference in the 2020 Annual Report from our [definitive proxy statement](#) for the 2021 Annual Meeting of Stockholders, filed with the SEC on April 20, 2021;
- Our Quarterly Report on [Form 10-Q](#) for the fiscal quarter ended March 31, 2021, filed with the SEC on May 6, 2021;
- Our Current Reports on Form 8-K filed with the SEC on [March 19, 2021](#), [June 7, 2021](#) and [June 11, 2021](#) (in each case, except for information contained therein which is furnished rather than filed); and
- The description of our Common Stock set forth in the registration statement on [Form 8-A](#) registering our Common Stock under Section 12 of the Exchange Act, which was filed with the SEC on November 15, 2017, including any amendments or reports filed for purposes of updating such description, including Exhibit 4.12 to the 2020 Annual Report.

We also incorporate by reference into this prospectus all documents (other than current reports furnished under Item 2.02 or Item 7.01 of Form 8-K and exhibits filed on such form that are related to such items) that are filed by us with the SEC pursuant to Sections 13(a), 13(c), 14 or 15(d) of the Exchange Act (i) after the date of the initial filing of the registration statement of which this prospectus forms a part and prior to effectiveness of the registration statement, or (ii) after the date of this prospectus but prior to the termination of the offering. These documents include periodic reports, such as Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q and Current Reports on Form 8-K, as well as proxy statements.

We will provide to each person, including any beneficial owner, to whom a prospectus is delivered, without charge upon written or oral request, a copy of any or all of the documents that are incorporated by reference into this prospectus but not delivered with the prospectus, including exhibits that are specifically incorporated by reference into such documents. You should direct any requests for documents to X4 Pharmaceuticals, Inc., Attn: Investor Relations, 61 North Beacon Street, 4th Floor, Boston, Massachusetts 02134.

Any statement contained in this prospectus or contained in a document incorporated or deemed to be incorporated by reference into this prospectus will be deemed to be modified or superseded to the extent that a statement contained in this prospectus or any subsequently filed supplement to this prospectus, or document deemed to be incorporated by reference into this prospectus, modifies or supersedes such statement.

6,321,836 Shares



Common Stock

PROSPECTUS

July 9, 2021
