

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 8-K

CURRENT REPORT
Pursuant to Section 13 or 15(d)
of the Securities Exchange Act of 1934

Date of Report (Date of earliest event reported): May 15, 2023

X4 PHARMACEUTICALS, INC.

(Exact name of registrant as specified in its charter)

Delaware
(State or other jurisdiction of incorporation)

001-38295
(Commission File Number)

27-3181608
(IRS Employer Identification No.)

61 North Beacon Street, 4th Floor
Boston, Massachusetts
(Address of principal executive offices)

02134
(Zip Code)

(857) 529-8300
(Registrant's telephone number, including area code)

Not applicable
(Former name or former address, if changed since last report)

Check the appropriate box below if the Form 8-K filing is intended to simultaneously satisfy the filing obligation of the registrant under any of the following provisions:

- Written communications pursuant to Rule 425 under the Securities Act (17 CFR 230.425)
- Soliciting material pursuant to Rule 14a-12 under the Exchange Act (17 CFR 240.14a-12)
- Pre-commencement communications pursuant to Rule 14d-2(b) under the Exchange Act (17 CFR 240.14d-2(b))
- Pre-commencement communications pursuant to Rule 13e-4(c) under the Exchange Act (17 CFR 240.13e-4(c))

Securities registered pursuant to Section 12(b) of the Act:

Title of each class
Common Stock, par value \$0.001 per share

Trading Symbol(s)
XFOR

Name of each exchange on which registered
The Nasdaq Stock Market LLC

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

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

Item 1.01 Entry into a Material Definitive Agreement.

Securities Purchase Agreement

On May 15, 2023, X4 Pharmaceuticals, Inc. (the "Company") entered into a securities purchase agreement (the "Securities Purchase Agreement") with several institutional accredited investors (the "Investors"), pursuant to which the Company agreed to issue and sell to the Investors in a private placement (the "Private Placement") (i) an aggregate of 34,521,046 shares (the "Shares") of the Company's common stock, par value \$0.001 per share (the "Common Stock"), at a purchase price of \$1.52 per Share, which represents the closing price of the Common Stock reported on The Nasdaq Capital Market on May 15, 2023, and (ii) with respect to certain Investors, in lieu of Shares, pre-funded warrants (the "Pre-Funded Warrants") to purchase an aggregate of 8,263,157 shares of Common Stock at a purchase price of \$1.519 per Pre-Funded Warrant. The price per Pre-Funded Warrant represents the price of \$1.52 per Share to be sold in the Private Placement, minus the \$0.001 per share exercise price of each such Pre-Funded Warrant. The Pre-Funded Warrants are exercisable at any time after their original issuance and will not expire until exercised in full.

The Pre-Funded Warrants to be issued in the Private Placement will provide that a holder of the 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 4.99% or 9.99% of the number of shares of the Company's 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 the Company, but not to any percentage in excess of 19.99%.

The Private Placement is expected to close on or about May 18, 2023, subject to the satisfaction of certain customary closing conditions. The Company expects to receive aggregate gross proceeds from the Private Placement of approximately \$65 million, before deducting the placement agent commissions and estimated offering expenses payable by the Company. The Company expects the net proceeds from the Private Placement to be used for continued clinical development and commercial readiness of its lead candidate, mavoxixafor, and for working capital, and general corporate purposes.

The foregoing descriptions of the Securities Purchase Agreement and the Pre-Funded Warrants do not purport to be complete and are qualified in their entirety by reference to such agreements, copies of which are filed as Exhibits 10.1 and 4.1 hereto, respectively, and incorporated by reference herein.

Registration Rights Agreement

Also on May 15, 2023, the Company entered into a registration rights agreement (the "Registration Rights Agreement") with the Investors, pursuant to which the Company agreed to register for resale the Shares and the issuance of the shares of Common Stock underlying the Pre-Funded Warrants held by the Investors (the "Registrable Securities"). Under the Registration Rights Agreement, the Company has agreed to file a registration statement covering the resale of the Registrable Securities promptly following the closing date of the Private Placement, and in no event later than thirty (30) days from the date of the Registration Rights Agreement (the "Filing Deadline"). The Company has agreed to use commercially reasonable efforts to cause such registration statement to become effective as soon as practicable and to keep such registration statement effective until the date the Shares and the shares of Common Stock underlying the Pre-Funded Warrants covered by such registration statement have been sold or may be resold pursuant to Rule 144 without restriction. The Company has agreed to be responsible for all fees and expenses incurred in connection with the registration of the Registrable Securities.

In the event (i) the registration statement has not been filed by the Filing Deadline, (ii) the registration statement has not been declared effective prior to the earlier of (A) five business days after the date which the Company is notified by the U.S. Securities and Exchange Commission (the "SEC") that the registration statement will not be reviewed by the SEC staff or is not subject to further comment by the SEC staff, or (B) 45 days following the Filing Deadline (or, in the event the SEC reviews and has written comments to the registration statement, 100 days following the Filing Deadline) or (iii) 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 the Company's failure to update such registration statement, subject to certain limited exceptions, then the Company has agreed to make pro

rata payments to each Investor as liquidated damages in an amount equal to 1% of the aggregate amount invested by each such Investor in the Registrable Securities 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 Company has granted the Investors customary indemnification rights in connection with the registration statement. The Investors have also granted the Company customary indemnification rights in connection with the registration statement.

The foregoing description of the Registration Rights Agreement does not purport to be complete and is qualified in its entirety by reference to the Registration Rights Agreement, a copy of which is filed as Exhibit 10.2 hereto and incorporated by reference herein.

Item 3.02 Unregistered Sales of Equity Securities.

The information contained above in Item 1.01 relating to the Private Placement is hereby incorporated by reference into this Item 3.02. Based in part upon the representations of the Investors in the Securities Purchase Agreement, the offering and sale of the securities will be made in reliance on the exemption afforded by Regulation D under the Securities Act of 1933, as amended (the "Securities Act"), and corresponding provisions of state securities or "blue sky" laws. The securities will not be registered under the Securities Act or any state securities laws and may not be offered or sold in the United States absent registration with the SEC or an applicable exemption from the registration requirements. The sale of the securities will not involve a public offering and will be made without general solicitation or general advertising. The Investors represented that they are accredited investors, as such term is defined in Rule 501(a) of Regulation D under the Securities Act, and that they are acquiring the securities for investment purposes only and not with a view to any resale, distribution or other disposition of the securities in violation of the U.S. federal securities laws.

Neither this Current Report on Form 8-K nor any exhibit attached hereto is an offer to sell or the solicitation of an offer to buy shares of Common Stock or other securities of the Company.

Item 7.01 Regulation FD Disclosure.

On May 16, 2023, the Company issued a press release announcing additional results from its global, pivotal, 4WHIM Phase 3 clinical trial of once-daily, oral mavoxixafor in individuals with WHIM (Warts, Hypogammaglobulinemia, Infections, and Myelokathexis) syndrome. A copy of the press release is furnished as Exhibit 99.2 hereto and incorporated by reference herein. The Company is hosting a webinar to discuss the results at 4:00 p.m., Eastern Time, on May 16, 2023. A live audio webcast of the presentation will be available under "Events and Presentations" in the "Investors" section of the Company's website at www.x4pharma.com. The webcast will be archived on the Company's website for at least 30 days. The information contained in, or that can be accessed through, the Company's website is not a part of this filing.

The information furnished under this Item 7.01, including Exhibit 99.2, shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or subject to the liabilities of that section. The information shall not be deemed incorporated by reference into any other filing with the SEC made by the Company, regardless of any general incorporation language in such filing.

Item 8.01 Other Events.

Private Placement Press Release

On May 16, 2023, the Company issued a press release announcing the pricing of the Private Placement. A copy of the press release is filed as Exhibit 99.1 hereto and incorporated by reference herein.

4WHIM Phase 3 Trial Results

As noted above under Item 7.01, the Company announced additional results from its global, pivotal, 4WHIM Phase 3 clinical trial of once-daily, oral mavoxixafor in individuals with WHIM syndrome on May 16, 2023. The Company is also hosting a webinar to discuss the results at 4:00 p.m., Eastern Time, on May 16, 2023.

Key highlights from the Company's webinar include:

- **Rate of Infections:** In the trial, mavoxixafor treatment resulted in a statistically significant reduction (~60%) in annualized infection rate versus placebo ($p < 0.01$). In addition, the data showed that the reduction was greater with time on treatment, with participants on mavoxixafor experiencing less than one infection per year versus 4.5 for those on placebo; during the second 6 months of the trial, the difference also achieved statistical significance ($p < 0.005$).
- **Severity of Infections:** During the trial, 29% (5 of 17) of those on placebo experienced Grade 3 or higher infections, whereas only 7%, (1 of 14) of those on mavoxixafor experienced a Grade 3 or higher infection, equating to a 75% reduction in the number of individuals experiencing severe infections. Importantly, the single Grade 3 infection in the mavoxixafor treatment arm occurred during the first 3 months of the trial; after 3 months of treatment, there were no serious infections in the mavoxixafor-arm, whereas the frequency of severe infections in those on placebo remained unchanged over the 52-week trial period.
- **Duration of Infections:** In the trial, mavoxixafor treatment reduced the total duration (in days) of infections by more than 70% as compared to placebo, with those on placebo experiencing a mean of 7 weeks (49.1 days) with infections over the 52-week trial period versus a mean of only 2 weeks (14.1 days) with infections for those treated with mavoxixafor.
- **Other Infection Metrics:** Mavoxixafor treatment resulted in a 40% lower total infection score, a metric that combines infection number and severity (LS mean [95% CI]: mavoxixafor, 7.41 [1.64–13.19]; placebo, 12.27 [7.24–17.30]). Treatment with mavoxixafor also resulted in reductions in upper and lower respiratory tract and skin infections compared with those on placebo; participants on placebo required greater medical intervention, with 10 of the 17 participants on placebo requiring treatment with antibiotics over the course of the study, versus 3 of the 14 receiving mavoxixafor; and slight improvements in warts were demonstrated both in the mavoxixafor and placebo arms (no difference between arms).
- **Safety and Tolerability:** As reported previously, mavoxixafor was generally well tolerated in the 4WHIM trial, with no drug-related serious adverse events, no treatment limiting toxicities, and no discontinuations due to safety. Approximately 90% of participants in the trial continued on to receive mavoxixafor treatment in the ongoing open-label extension study.

A copy of the slide presentation for the Company's webinar is being filed as Exhibit 99.3 hereto and incorporated by reference herein. The Company undertakes no obligation to update, supplement or amend the materials attached hereto as Exhibit 99.3.

Forward-Looking Statements

This Form 8-K contains forward-looking statements within the meaning of The Private Securities Litigation Reform Act of 1995, including without limitation statements regarding the expected closing of the Private Placement, anticipated proceeds from the Private Placement and the use thereof, the Company's plans to file a registration statement to register the resale of the shares of Common Stock to be issued and sold in the Private Placement and the issuance of the shares of Common Stock issuable upon exercise of the Pre-Funded Warrants, and the clinical progress of X4's pipeline development programs, including the anticipated New Drug Application submission for mavoxixafor for the treatment of WHIM syndrome and the timing thereof. The words "anticipate," "believe," "continue," "could," "estimate," "expect," "intend," "may," "plan," "potential," "predict," "project," "target," "should," "would," and similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words. Actual results or events could differ materially from the plans, intentions and expectations disclosed in these forward-looking statements as a result of various important factors, including risks relating to the Company's inability, or the inability of the Investors, to satisfy the conditions to closing for the Private Placement; the closing of the Private Placement; on account of uncertainties inherent in the

initiation and completion of clinical trials and clinical development; the risk that trials and studies may not have satisfactory outcomes; the risk that the outcomes of preclinical studies or earlier clinical trials will not be predictive of later clinical trial results; the risk that initial or interim results from a clinical trial may not be predictive of the final results of the trial or the results of future trials; the potential adverse effects arising from the testing or use of mavorixafor or other product candidates; the risk that the U.S. Food and Drug Administration (FDA) may not accept a regulatory submission for mavorixafor; the risk that the FDA may not approve mavorixafor for WHIM syndrome; the risks related to X4's ability to raise additional capital; the impacts of general macroeconomic and geopolitical conditions, rising inflation, and uncertain credit and financial markets on X4's business, clinical trials, and financial position; and other risks and uncertainties described under the caption "Risk Factors" in the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2023, which is on file with the SEC; and risks described in other filings that the Company makes with the SEC in the future. Any forward-looking statements contained in this Form 8-K speak only as of the date hereof, and the Company expressly disclaims any obligation to update any forward-looking statements, whether because of new information, future events or otherwise.

Item 9.01 Financial Statements and Exhibits.

<u>Exhibit No.</u>	<u>Description</u>
4.1	Form of May 2023 Pre-Funded Warrant.
10.1	Securities Purchase Agreement, dated May 15, 2023, by and among X4 Pharmaceuticals, Inc. and the persons party thereto.
10.2	Registration Rights Agreement, dated May 15, 2023, by and among X4 Pharmaceuticals, Inc. and the persons party thereto.
99.1	Press release announcing Private Placement, dated May 16, 2023.
99.2	Press Release announcing 4WHIM Phase 3 trial results, dated May 16, 2023.
99.3	Webinar Presentation, dated May 16, 2023.
104	Cover Page Interactive Data File (embedded within the Inline XBRL document)

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934 the registrant has duly caused this report to be signed on its behalf by the undersigned hereunto duly authorized.

X4 PHARMACEUTICALS, INC.

Date: May 16, 2023

By: /s/ Adam Mostafa
Adam Mostafa
Chief Financial Officer

THESE SECURITIES REPRESENTED HEREBY AND THE SECURITIES ISSUABLE UPON EXERCISE OF THESE SECURITIES HAVE NOT BEEN REGISTERED WITH THE SECURITIES AND EXCHANGE COMMISSION OR THE SECURITIES COMMISSION OF ANY STATE BUT HAVE BEEN OR WILL BE ISSUED IN RELIANCE UPON AN EXEMPTION FROM REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED, AND, ACCORDINGLY, MAY NOT BE TRANSFERRED UNLESS (i) SUCH SECURITIES HAVE BEEN REGISTERED FOR SALE PURSUANT TO THE SECURITIES ACT OF 1933, AS AMENDED, (ii) SUCH SECURITIES MAY BE SOLD PURSUANT TO RULE 144, (iii) THE COMPANY HAS RECEIVED AN OPINION OF COUNSEL REASONABLY SATISFACTORY TO IT THAT SUCH TRANSFER MAY LAWFULLY BE MADE WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED, OR (iv) THE SECURITIES ARE TRANSFERRED WITHOUT CONSIDERATION TO AN AFFILIATE OF SUCH HOLDER OR A CUSTODIAL NOMINEE (WHICH FOR THE AVOIDANCE OF DOUBT SHALL REQUIRE NEITHER CONSENT NOR THE DELIVERY OF AN OPINION).

X4 PHARMACEUTICALS, INC.

FORM OF PRE-FUNDED WARRANT TO PURCHASE COMMON STOCK

Warrant No. PF-May 2023-[•]

Number of Shares: [•]
(subject to adjustment)

Original Issue Date: May [•], 2023

X4 Pharmaceuticals, Inc., a Delaware corporation (the "Company"), hereby certifies that, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, [•] or its permitted assigns (the "Holder"), is entitled, subject to the terms set forth below, to purchase from the Company up to a total of [•] shares of common stock, \$0.001 par value per share (the "Common Stock"), of the Company (each such share, a "Warrant Share" and all such shares, the "Warrant Shares") at an exercise price per share equal to \$0.001 per share (as adjusted from time to time as provided in Section 9 herein, the "Exercise Price"), upon surrender of this Warrant to Purchase Common Stock (including any Warrants to Purchase Common Stock issued in exchange, transfer or replacement hereof, the "Warrant"), and subject to the following terms and conditions:

1. Definitions. For purposes of this Warrant, the following terms shall have the following meanings:

(a) "Affiliate" means any Person that, directly or indirectly through one or more intermediaries, controls or is controlled by or is under common control with a Person, as such terms are used in and construed under Rule 405 under the Securities Act.

(b) "Attribution Parties" means, collectively, the following Persons and entities: (i) any direct or indirect Affiliates of the Holder, (ii) any Person acting or who could be deemed to be acting as a Group together with the Holder or any of the foregoing and (iii) any other Persons whose beneficial ownership of the Company's Common Stock would or could be aggregated with the Holder's and the other Attribution Parties for purposes of Section 13(d) or Section 16 of the Exchange Act. For clarity, the purpose of the foregoing is to subject collectively the Holder and all other Attribution Parties to the Maximum Percentage.

(c) "Closing Sale Price" means, for any security as of any date, the last trade price for such security on the Principal Trading Market for such security, as reported by Bloomberg Financial Markets, or, if such Principal Trading Market begins to operate on an extended hours basis and does not designate the last trade price, then the last trade price of such security prior to 4:00 P.M., New York City time, as reported by Bloomberg Financial Markets, or if the foregoing do not apply, the last trade price of such security in the over-the-counter market on the electronic bulletin board for such security as reported by Bloomberg Financial Markets, or, if no last trade price is reported for such security by Bloomberg Financial Markets, the average of the bid and ask prices, of any market makers for such security as reported in the OTC Link or "pink sheets" by OTC Markets Group Inc. (formerly OTC Markets Inc.). If the Closing Sale Price cannot be calculated for a security on a particular date on any of the foregoing bases, the Closing Sale Price of such security on such date shall be the fair market value as mutually determined by the Company and the Holder. If the Company and the Holder are unable to agree upon the fair market value of such security, then the Board of Directors of the Company shall use its good faith judgment to determine the fair market value. The determination of the Board of Directors of the Company shall be binding upon all parties absent

demonstrable error. All such determinations shall be appropriately adjusted for any stock dividend, stock split, stock combination or other similar transaction during the applicable calculation period.

(d) “Exchange Act” means the Securities Exchange Act of 1934, as amended.

(e) “Person” means an individual, a limited liability company, a partnership, a joint venture, a corporation, a trust, an unincorporated organization, any other entity and a government or any department or agency thereof.

(f) “Principal Trading Market” means the national securities exchange or other trading market on which the Common Stock is primarily listed on and quoted for trading, which, as of the Original Issue Date shall be the Nasdaq Capital Market.

(g) “SEC” means the United States Securities and Exchange Commission.

(h) “Securities Act” means the Securities Act of 1933, as amended.

(i) “Standard Settlement Period” means the standard settlement period, expressed in a number of Trading Days, for the Company’s primary trading market or quotation system with respect to the Common Stock that is in effect on the date of delivery of an applicable Exercise Notice, which as of the Issuance Date was “T+2”.

(j) “Trading Day” means any weekday on which the Principal Trading Market is normally open for trading.

(k) “Transfer Agent” means Computershare Trust Company, N.A., the Company’s transfer agent and registrar for the Common Stock, and any successor appointed in such capacity.

(l) “Warrant Agent” means the Company.

2. Registration of Warrants. The Company shall register ownership of this Warrant, upon records to be maintained by the Warrant Agent for that purpose (the “Warrant Register”), in the name of the record Holder (which shall include the initial Holder or, as the case may be, any registered assignee to which this Warrant is permissibly assigned hereunder) from time to time. The Company may deem and treat the registered Holder of this Warrant as the absolute owner hereof for the purpose of any exercise hereof or any distribution to the Holder, and for all other purposes, absent actual notice to the contrary.

3. Registration of Transfers. Subject to compliance with all applicable securities laws, the Company shall, or will cause the Warrant Agent to, register the transfer of all or any portion of this Warrant in the Warrant Register, upon surrender of this Warrant, together with a written assignment of this Warrant substantially in the form attached hereto as Schedule 2 duly executed by the Holder, and payment for all applicable transfer taxes accompanied by reasonable evidence of authority of the party making such request that may be required by the Warrant Agent including, but not limited to, the signature guarantee of a guarantor institution which is a participant in a signature guarantee program approved by the Securities Transfer Association. Upon any such registration or transfer, a new warrant to purchase Common Stock in substantially the form of this Warrant (any such new warrant, a “New Warrant”) evidencing the portion of this Warrant so transferred shall be issued to the transferee, and a New Warrant evidencing the remaining portion of this Warrant not so transferred, if any, shall be issued to the transferring Holder. The acceptance of the New Warrant by the transferee thereof shall be deemed the acceptance by such transferee of all of the rights and obligations in respect of the New Warrant that the Holder has in respect of this Warrant. The Company shall, or will cause the Warrant Agent to, prepare, issue and deliver at the Company’s own expense any New Warrant under this Section 3. Until due presentment for registration of transfer, the Company may treat the registered Holder hereof as the owner and holder for all purposes, and the Company shall not be affected by any notice to the contrary.

4. Exercise of Warrants.

(a) All or any part of this Warrant shall be exercisable by the registered Holder in any manner permitted by Section 10 of this Warrant at any time and from time to time on or after the Original Issue Date.

(b) The Holder may exercise this Warrant by delivering to the Company (i) an exercise notice, in the form attached as Schedule 1 hereto (the “Exercise Notice”), completed and duly signed, and (ii) payment of the Exercise Price for the number of Warrant Shares as to which this Warrant is being exercised (which may take the form of a “cashless exercise” if so indicated in the Exercise Notice pursuant to Section 10 below), and the date on which the last of such items is delivered to the Company (as determined in accordance with the notice provisions hereof) is an “Exercise Date.” The Holder shall not be required to deliver the original Warrant in order to effect an exercise hereunder.

Execution and delivery of the Exercise Notice shall have the same effect as cancellation of the original Warrant and issuance of a New Warrant evidencing the right to purchase the remaining number of Warrant Shares, if any.

5. Delivery of Warrant Shares.

(a) Upon exercise of this Warrant, the Company shall, or shall cause the Transfer Agent to, promptly (but in no event later than the number of Trading Days comprising the Standard Settlement Period) credit such aggregate number of shares of Common Stock to which the Holder is entitled pursuant to such exercise to the Holder's or its designee's balance account with The Depository Trust Company ("DTC") through its Deposit/Withdrawal At Custodian system provided that the Transfer Agent is then a participant in the DTC Fast Automated Securities Transfer Program and either (A) there is an effective registration statement permitting the issuance of such Warrant Shares to or resale of such Warrant Shares by the Holder or (B) such Warrant Shares are eligible for resale by the Holder without volume or manner-of-sale limitations pursuant to Rule 144 promulgated under the Securities Act (assuming cashless exercise of this Warrant), and otherwise issue such Warrant Shares in the name of the Holder or its designee in restricted book-entry form in the Company's share register. The Holder, or any natural person or legal entity (each, a "Person") permissibly so designated by the Holder to receive Warrant Shares, shall be deemed to have become the holder of record of such Warrant Shares as of the Exercise Date, irrespective of the date such Warrant Shares are credited to the Holder's or its designee's DTC account or the date of the book entry positions evidencing such Warrant Shares, as the case may be.

(b) If within the Standard Settlement Period after the Exercise Date, the Company fails to deliver to the Holder or its designee the required number of Warrant Shares in the manner required pursuant to Section 5(a) or fails to credit the Holder's or its designee's balance account with DTC for such number of Warrant Shares to which the Holder is entitled (other than a failure caused by incorrect or incomplete information provided by the Holder to the Company), and if after such number of Trading Days comprising the Standard Settlement Period and prior to the receipt of such Warrant Shares, the Holder purchases (in an open market transaction or otherwise) shares of Common Stock to deliver in satisfaction of a sale by the Holder of the Warrant Shares which the Holder anticipated receiving upon such exercise (a "Buy-In"), then the Company shall, within two (2) Trading Days after the Holder's request and in the Holder's sole discretion, either (1) pay in cash to the Holder an amount equal to the Holder's total purchase price (including brokerage commissions, if any) for the shares of Common Stock so purchased, at which point the Company's obligation to issue such Warrant Shares shall terminate or (2) promptly honor its obligation to deliver to the Holder or its designee such Warrant Shares or credit the Holder's or its designee's balance account with DTC for such Warrant Shares and pay cash to the Holder in an amount equal to the Holder's total purchase price (including brokerage commissions, if any) for the shares of Common Stock so purchased in the Buy-In, less the product of (A) the number of shares of Common Stock purchased in the Buy-In, times (B) the Closing Sale Price of a share of Common Stock on the Exercise Date.

(c) To the extent permitted by law and subject to Section 5(b), the Company's obligations to issue and deliver Warrant Shares in accordance with and subject to the terms hereof (including the limitations set forth in Section 11 below) are absolute and unconditional, irrespective of any action or inaction by the Holder to enforce the same, any waiver or consent with respect to any provision hereof, the recovery of any judgment against any Person or any action to enforce the same, or any setoff, counterclaim, recoupment, limitation or termination, or any breach or alleged breach by the Holder or any other Person of any obligation to the Company or any violation or alleged violation of law by the Holder or any other Person, and irrespective of any other circumstance that might otherwise limit such obligation of the Company to the Holder in connection with the issuance of Warrant Shares. Subject to Section 5(b), nothing herein shall limit the Holder's right to pursue any other remedies available to it hereunder, at law or in equity including, without limitation, a decree of specific performance and/or injunctive relief with respect to the Company's failure to timely deliver shares of Common Stock upon exercise of the Warrant as required pursuant to the terms hereof.

6. Charges, Taxes and Expenses. Issuance and delivery of shares of Common Stock upon exercise of this Warrant shall be made without charge to the Holder for any issue or transfer tax, transfer agent fee or other incidental tax or expense (excluding any applicable stamp duties) in respect of the issuance of such shares, all of which taxes and expenses shall be paid by the Company; provided, however, that the Company shall not be required to pay any tax that may be payable in respect of any transfer involved in the registration of any Warrant Shares or the Warrants in a name other than that of the Holder or an Affiliate thereof. The Holder shall be responsible for all other tax liability that may arise as a result of holding or transferring this Warrant or receiving Warrant Shares upon exercise hereof.

7. Replacement of Warrant. If this Warrant is mutilated, lost, stolen or destroyed, the Company shall issue or cause to be issued in exchange and substitution for and upon cancellation hereof, or in lieu of and substitution for this Warrant, a New Warrant, but only upon receipt of evidence reasonably satisfactory to the Company of such loss, theft or destruction (in such case) and, in each case, a customary and reasonable indemnity, if requested by the Company, but without any requirement that a surety bond be procured, provided or posted unless requested by a

third-party transfer agent. Applicants for a New Warrant under such circumstances shall also comply with such other reasonable regulations and procedures and pay such other reasonable third-party costs as the Company may prescribe. If a New Warrant is requested as a result of a mutilation of this Warrant, then the Holder shall deliver such mutilated Warrant to the Company as a condition precedent to the Company's obligation to issue the New Warrant.

8. Reservation of Warrant Shares. The Company covenants that it will, at all times while this Warrant is outstanding, reserve and keep available out of the aggregate of its authorized but unissued and otherwise unreserved Common Stock, solely for the purpose of enabling it to issue Warrant Shares upon exercise of this Warrant as herein provided, the number of Warrant Shares that are issuable and deliverable upon the exercise of this entire Warrant, free from preemptive rights or any other contingent purchase rights of persons other than the Holder (taking into account the adjustments and restrictions of Section 9). The failure of the Company to reserve and keep available out of the aggregate of its authorized but unissued and otherwise unreserved Common Stock a sufficient number of shares of Common Stock to enable it to issue Warrant Shares upon exercise of this Warrant as herein provided is referred to herein as an "**Authorized Share Failure**." The Company covenants that all Warrant Shares so issuable and deliverable shall, upon issuance and the payment of the applicable Exercise Price in accordance with the terms hereof, be duly and validly authorized, issued and fully paid and non-assessable. The Company will take all actions as may be necessary to assure that such shares of Common Stock may be issued as provided herein without violation of any applicable law or regulation, or of any requirements of any securities exchange or automated quotation system upon which the Common Stock may be listed. The Company further covenants that it will not, without the prior written consent of the Holder, take any actions to increase the par value of the Common Stock at any time while this Warrant is outstanding. In furtherance of the Company's obligations set forth in this Section 8, as soon as practicable after the date of the occurrence of an Authorized Share Failure, but in no event later than ninety (90) days after the occurrence of such Authorized Share Failure, the Company shall hold a meeting of its stockholders for the approval of an increase in the number of authorized shares of Common Stock. In connection with such meeting, the Company shall provide each stockholder with a proxy statement and shall use its reasonable best efforts to solicit its stockholders' approval of such increase in authorized shares of Common Stock and to cause its board of directors to recommend to the stockholders that they approve such proposal. Notwithstanding the foregoing, if any such time of an Authorized Share Failure, the Company is able to obtain the written consent of a majority of the shares of its issued and outstanding shares of Common Stock to approve the increase in the number of authorized shares of Common Stock, the Company may satisfy this obligation by obtaining such consent and submitting for filing with the SEC an Information Statement on Schedule 14C.

9. Certain Adjustments. The Exercise Price and number of Warrant Shares issuable upon exercise of this Warrant are subject to adjustment from time to time as set forth in this Section 9.

(a) **Stock Dividends and Splits.** If the Company, at any time while this Warrant is outstanding, (i) pays a stock dividend on its Common Stock or otherwise makes a distribution on any class of capital stock issued and outstanding on the Original Issue Date and in accordance with the terms of such stock on the Original Issue Date or as amended, that is payable in shares of Common Stock, (ii) subdivides its outstanding shares of Common Stock into a larger number of shares of Common Stock, (iii) combines its outstanding shares of Common Stock into a smaller number of shares of Common Stock or (iv) issues by reclassification of shares of capital stock any additional shares of Common Stock of the Company, then in each such case the Exercise Price shall be multiplied by a fraction, the numerator of which shall be the number of shares of Common Stock outstanding immediately before such event and the denominator of which shall be the number of shares of Common Stock outstanding immediately after such event. Any adjustment made pursuant to clause (i) of this paragraph shall become effective immediately after the record date for the determination of stockholders entitled to receive such dividend or distribution, provided, however, that if such record date shall have been fixed and such dividend is not fully paid on the date fixed therefor, the Exercise Price shall be recomputed accordingly as of the close of business on such record date and thereafter the Exercise Price shall be adjusted pursuant to this paragraph as of the time of actual payment of such dividends. Any adjustment pursuant to clause (ii) or (iii) of this paragraph shall become effective immediately after the effective date of such subdivision or combination.

(b) **Pro Rata Distributions.** If, on or after the Original Issue Date, the Company shall declare or make any dividend or other pro rata distribution of its assets (or rights to acquire its assets) to holders of shares of Common Stock, by way of return of capital or otherwise (including, without limitation, any distribution of cash, stock or other securities, property, options, evidence of indebtedness or any other assets by way of a dividend, spin off, reclassification, corporate rearrangement, scheme of arrangement or other similar transaction, but, for the avoidance of doubt, excluding any distribution of shares of Common Stock subject to Section 9(a), any distribution of Purchase Rights (as defined below) subject to Section 9(c) and any Fundamental Transaction (as defined below) subject to Section 9(d)) (a "**Distribution**") then, in each such case, the Holder shall be entitled to participate in such Distribution to the same extent that the Holder would have participated therein if the Holder had held the number of shares of Common Stock acquirable upon complete exercise of this Warrant (without regard to any limitations or restrictions on exercise of this Warrant, including without limitation, the Maximum Percentage (as defined below))

immediately before the date on which a record is taken for such Distribution, or, if no such record is taken, the date as of which the record holders of shares of Common Stock are to be determined for the participation in such Distribution (provided, that to the extent that the Holder's right to participate in any such Distribution would result in the Holder and the other Attribution Parties exceeding the Maximum Percentage, then the Holder shall not be entitled to participate in such Distribution to such extent (and shall not be entitled to beneficial ownership of such shares of Common Stock as a result of such Distribution (and beneficial ownership) to such extent) and the portion of such Distribution shall be held in abeyance for the benefit of the Holder until such time or times as its right thereto would not result in the Holder and the other Attribution Parties exceeding the Maximum Percentage, at which time or times the Holder shall be granted such Distribution (and any Distributions declared or made on such initial Distribution or on any subsequent Distribution held similarly in abeyance) to the same extent as if there had been no such limitation).

(c) **Purchase Rights.** If at any time on or after the Original Issue Date, the Company grants, issues or sells any Options, Convertible Securities or rights to purchase stock, warrants, securities or other property, in each case pro rata to the record holders of any class of Common Stock (the "**Purchase Rights**"), then the Holder will be entitled to acquire, upon the terms applicable to such Purchase Rights, the aggregate Purchase Rights which the Holder could have acquired if the Holder had held the number of shares of Common Stock acquirable upon complete exercise of this Warrant (without regard to any limitations or restrictions on exercise of this Warrant, including without limitation, the Maximum Percentage) immediately before the date on which a record is taken for the grant, issuance or sale of such Purchase Rights, or, if no such record is taken, the date as of which the record holders of Common Stock are to be determined for the grant, issuance or sale of such Purchase Rights (provided, that to the extent that the Holder's right to participate in any such Purchase Right would result in the Holder and the other Attribution Parties exceeding the Maximum Percentage, then the Holder shall not be entitled to participate in such Purchase Right to such extent (and shall not be entitled to beneficial ownership of such Common Stock as a result of such Purchase Right (and beneficial ownership) to such extent) and such Purchase Right to such extent shall be held in abeyance for the benefit of the Holder until such time or times as its right thereto would not result in the Holder and the other Attribution Parties exceeding the Maximum Percentage, at which time or times the Holder shall be granted such right (and any Purchase Right granted, issued or sold on such initial Purchase Right or on any subsequent Purchase Right to be held similarly in abeyance) to the same extent as if there had been no such limitation). As used in this Section 9(c), (i) "**Options**" means any rights, warrants or options to subscribe for or purchase shares of Common Stock or Convertible Securities and (ii) "**Convertible Securities**" mean any stock or securities (other than Options) directly or indirectly convertible into or exercisable or exchangeable for shares of Common Stock.

(d) **Fundamental Transactions.** If, at any time while this Warrant is outstanding (i) the Company effects any merger or consolidation of the Company with or into another Person, in which the Company is not the surviving entity or the stockholders of the Company immediately prior to such merger or consolidation do not own, directly or indirectly, at least 50% of the voting power of the surviving entity immediately after such merger or consolidation, (ii) the Company effects any sale to another Person of all or substantially all of its assets in one or a series of related transactions, (iii) pursuant to any tender offer or exchange offer (whether by the Company or another Person), holders of capital stock who tender shares representing more than 50% of the voting power of the capital stock of the Company and the Company or such other Person, as applicable, accepts such tender for payment, (iv) the Company consummates a stock purchase agreement or other business combination (including, without limitation, a reorganization, recapitalization, spin-off or scheme of arrangement) with another Person whereby such other Person acquires more than the 50% of the voting power of the capital stock of the Company (except for any such transaction in which the stockholders of the Company immediately prior to such transaction maintain, in substantially the same proportions, the voting power of such Person immediately after the transaction) or (v) the Company effects any reclassification of the Common Stock or any compulsory share exchange pursuant to which the Common Stock is effectively converted into or exchanged for other securities, cash or property (other than as a result of a subdivision or combination of shares of Common Stock covered by Section 9(a) above) (in any such case, a "**Fundamental Transaction**"), then following such Fundamental Transaction the Holder shall have the right to receive, upon exercise of this Warrant, the same amount and kind of securities, cash or property as it would have been entitled to receive upon the occurrence of such Fundamental Transaction if it had been, immediately prior to such Fundamental Transaction, the holder of the number of Warrant Shares then issuable upon exercise in full of this Warrant without regard to any limitations on exercise contained herein (the "**Alternate Consideration**"). The Company shall not effect any Fundamental Transaction in which the Company is not the surviving entity or the Alternate Consideration includes securities of another Person unless (i) the Alternate Consideration is solely cash and the Company provides for the simultaneous "cashless exercise" of this Warrant pursuant to Section 10 below or (ii) prior to or simultaneously with the consummation thereof, any successor to the Company, surviving entity or other Person (including any purchaser of assets of the Company) shall assume the obligation to deliver to the Holder such Alternate Consideration as, in accordance with the foregoing provisions, the Holder may be entitled to receive, and the other obligations under this Warrant. The provisions of this paragraph (d) shall similarly apply to subsequent transactions analogous of a Fundamental Transaction type.

(e) **Number of Warrant Shares.** Simultaneously with any adjustment to the Exercise Price pursuant to paragraph (a) of this Section 9, the number of Warrant Shares that may be purchased upon exercise of this Warrant shall be increased or decreased proportionately, so that after such adjustment the aggregate Exercise Price payable hereunder for the increased or decreased number of Warrant Shares shall be the same as the aggregate Exercise Price in effect immediately prior to such adjustment.

(f) **Calculations.** All calculations under this Section 9 shall be made to the nearest one tenth of one cent or the nearest share, as applicable.

(g) **Notice of Adjustments.** Upon the occurrence of each adjustment pursuant to this Section 9, the Company at its expense will, at the written request of the Holder, promptly compute such adjustment, in good faith, in accordance with the terms of this Warrant and prepare a certificate setting forth such adjustment, including a statement of the adjusted Exercise Price and adjusted number or type of Warrant Shares or other securities issuable upon exercise of this Warrant (as applicable), describing the transactions giving rise to such adjustments and showing in detail the facts upon which such adjustment is based. Upon written request, the Company will promptly deliver a copy of each such certificate to the Holder and to the Company's transfer agent.

(h) **Notice of Corporate Events.** If, while this Warrant is outstanding, the Company (i) declares a dividend or any other pro rata distribution of cash, securities or other property in respect of its Common Stock, including, without limitation, any granting of rights or warrants to subscribe for or purchase any capital stock of the Company or any subsidiary, (ii) authorizes or approves, enters into any agreement contemplating or solicits stockholder approval for any Fundamental Transaction or (iii) authorizes the voluntary dissolution, liquidation or winding up of the affairs of the Company, then the Company shall deliver to the Holder a notice of such transaction at least fifteen (15) days prior to the applicable record or effective date on which a Person would need to hold Common Stock in order to participate in or vote with respect to such transaction; provided, however, that the failure to deliver such notice or any defect therein shall not affect the validity of the corporate action required to be described in such notice. In addition, if while this Warrant is outstanding, the Company authorizes or approves, enters into any agreement contemplating or solicits stockholder approval for any Fundamental Transaction contemplated by Section 9(d), other than a Fundamental Transaction under clause (iii) of Section 9(d), the Company shall deliver to the Holder a notice of such Fundamental Transaction at least thirty (30) days prior to the date such Fundamental Transaction is consummated. The Holder agrees to maintain any information disclosed pursuant to this Section 9(h) in confidence until such information is publicly available, and shall comply with applicable law with respect to trading in the Company's securities following receipt of any such information.

10. **Payment of Exercise Price.** Notwithstanding anything contained herein to the contrary, the Holder may, in its sole discretion, satisfy its obligation to pay the Exercise Price through a "cashless exercise," in which event the Company shall issue to the Holder the number of Warrant Shares in an exchange of securities effected pursuant to Section 3(a)(9) of the Securities Act, determined as follows:

$$X = Y [(A-B)/A]$$

where:

"X" equals the number of Warrant Shares to be issued to the Holder;

"Y" equals the total number of Warrant Shares with respect to which this Warrant is then being exercised;

"A" equals the Closing Sale Price of the shares of Common Stock (as reported by Bloomberg Financial Markets) as of the Trading Day on the date immediately preceding the Exercise Date; and

"B" equals the Exercise Price then in effect for the applicable Warrant Shares at the time of such exercise.

For purposes of Rule 144 promulgated under the Securities Act, it is intended, understood and acknowledged that the Warrant Shares issued in a "cashless exercise" transaction shall be deemed to have been acquired by the Holder, and the holding period for the Warrant Shares shall be deemed to have commenced, on the date this Warrant was originally issued (provided that the SEC continues to take the position that such treatment is proper at the time of such exercise).

In the event that a registration statement registering the issuance of the Warrant Shares is, for any reason, not effective at the time of exercise of this Warrant, then the Warrant may only be exercised through a cashless exercise, as set forth in this Section 10. If Warrant Shares are issued in such a cashless exercise, the Company acknowledges and agrees that, in accordance with Section 3(a)(9) of the Securities Act, the Warrant Shares shall take on the

characteristics of the Warrants being exercised, and the holding period of the Warrants being exercised may be tacked on to the holding period of the Warrant Shares (provided that the SEC continues to take the position that such treatment is proper at the time of such exercise).

11. Limitations on Exercise.

(a) Notwithstanding anything to the contrary contained herein, the Company shall not effect the exercise of any portion of this Warrant, and the Holder shall not have the right to exercise any portion of this Warrant, pursuant to the terms and conditions of this Warrant and any such exercise shall be null and void and treated as if never made, to the extent that immediately prior to or after giving effect to such exercise, the Holder together with the other Attribution Parties collectively would beneficially own in excess of 9.99% (the "Maximum Percentage") of the number of shares of Common Stock outstanding immediately after giving effect to such exercise. For purposes of the foregoing sentence, the aggregate number of shares of Common Stock beneficially owned by the Holder and the other Attribution Parties shall include the number of shares of Common Stock held by the Holder and all other Attribution Parties plus the number of shares of Common Stock issuable upon exercise of this Warrant with respect to which the determination of such sentence is being made, but shall exclude the number of shares of Common Stock which would be issuable upon (A) exercise of the remaining, unexercised portion of this Warrant beneficially owned by the Holder or any of the other Attribution Parties and (B) exercise or conversion of the unexercised or unconverted portion of any other securities of the Company (including, without limitation, any convertible notes or convertible preferred stock or warrants, including the other Warrants) beneficially owned by the Holder or any other Attribution Party subject to a limitation on conversion or exercise analogous to the limitation contained in this Section 11(a). For purposes of this Section 11(a), beneficial ownership shall be calculated in accordance with Section 13(d) of the Exchange Act, it being acknowledged by the Holder that the Company is not representing to the Holder that such calculation is in compliance with Section 13(d) of the Exchange Act and the Holder is solely responsible for any schedules required to be filed in accordance therewith. To the extent that the limitation contained in this Section 11(a) applies, the determination of whether this Warrant is exercisable (in relation to other securities owned by the Holder together with any Affiliates and Attribution Parties) and of which portion of this Warrant is exercisable shall be in the sole discretion of the Holder, and the Company shall have no obligation to verify or confirm the accuracy of such determination. In addition, a determination as to any group status as contemplated above shall be determined in accordance with Section 13(d) of the Exchange Act and the rules and regulations promulgated thereunder. For purposes of this Warrant, in determining the number of outstanding shares of Common Stock the Holder may acquire upon the exercise of this Warrant without exceeding the Maximum Percentage, the Holder may rely on the number of outstanding shares of Common Stock as reflected in (x) the Company's most recent Annual Report on Form 10-K, Quarterly Report on Form 10-Q and Current Reports on Form 8-K or other public filing with the SEC, as the case may be, (y) a more recent public announcement by the Company or (z) any other written notice by the Company setting forth the number of shares of Common Stock outstanding (the "Reported Outstanding Share Number"). If the Company receives an Exercise Notice from the Holder at a time when the actual number of outstanding shares of Common Stock is less than the Reported Outstanding Share Number, the Company shall (i) notify the Holder in writing of the number of shares of Common Stock then outstanding and, to the extent that such Exercise Notice would otherwise cause the Holder's beneficial ownership, as determined pursuant to this Section 11(a), to exceed the Maximum Percentage, the Holder must notify the Company of a reduced number of Warrant Shares to be purchased pursuant to such Exercise Notice (the number of shares by which such purchase is reduced, the "Reduction Shares") and (ii) as soon as reasonably practicable, the Company shall return to the Holder any exercise price paid by the Holder for the Reduction Shares. For any reason at any time, upon the written or oral request of the Holder, the Company shall within one (1) Business Day confirm orally and in writing or by electronic mail to the Holder the number of shares of Common Stock then outstanding. In any case, the number of outstanding shares of Common Stock shall be determined after giving effect to the conversion or exercise of securities of the Company, including this Warrant, by the Holder and any other Attribution Party since the date as of which the Reported Outstanding Share Number was reported. In the event that the issuance of Common Stock to the Holder upon exercise of this Warrant results in the Holder and the other Attribution Parties being deemed to beneficially own, in the aggregate, more than the Maximum Percentage of the number of outstanding shares of Common Stock (as determined under Section 13(d) of the Exchange Act), the number of shares so issued by which the Holder's and the other Attribution Parties' aggregate beneficial ownership exceeds the Maximum Percentage (the "Excess Shares") shall be deemed null and void and shall be cancelled ab initio, and the Holder shall not have the power to vote or to transfer the Excess Shares. As soon as reasonably practicable after the issuance of the Excess Shares has been deemed null and void, the Company shall return to the Holder the exercise price paid by the Holder for the Excess Shares. Upon delivery of a written notice to the Company, the Holder may from time to time increase or decrease the Maximum Percentage to any other percentage (not in excess of 19.99% of the issued and outstanding shares of Common Stock immediately after giving effect to the issuance of the shares of Common Stock issuable upon exercise of this Warrant if exceeding that limit would result in a change of control under Nasdaq Listing Rule 5636(b) or any successor rule) as specified in such notice; provided that (i) any such increase in the Maximum Percentage will not be effective until the sixty-first (61st) day after such notice is delivered to the Company and (ii) any such increase or decrease will apply only to the Holder and the other Attribution Parties and not to any other holder of Warrants that is not an Attribution Party of the Holder, and (iii) no such decrease shall affect the validity of

any prior exercise of Warrants by Holder or any Attribution Party. For purposes of clarity, the shares of Common Stock issuable pursuant to the terms of this Warrant in excess of the Maximum Percentage shall not be deemed to be beneficially owned by the Holder for any purpose including for purposes of Section 13(d) of the Exchange Act or Rule 16a-1(a)(1) promulgated under the Exchange Act. No prior inability to exercise this Warrant pursuant to this paragraph shall have any effect on the applicability of the provisions of this paragraph with respect to any subsequent determination of exercisability. The provisions of this paragraph shall be construed and implemented in a manner otherwise than in strict conformity with the terms of this Section 11(a) to the extent necessary to correct this paragraph or any portion of this paragraph which may be defective or inconsistent with the intended beneficial ownership limitation contained in this Section 11(a) or to make changes or supplements necessary or desirable to properly give effect to such limitation. The limitation contained in this paragraph may not be waived and shall apply to a successor holder of this Warrant.

(b) This Section 11 shall not restrict the number of shares of Common Stock which a Holder may receive or beneficially own in order to determine the amount of securities or other consideration that such Holder may receive in the event of a Fundamental Transaction as contemplated in Section 9(d) of this Warrant.

12. **No Fractional Shares.** No fractional Warrant Shares will be issued in connection with any exercise of this Warrant. In lieu of any fractional shares that would otherwise be issuable, the number of Warrant Shares to be issued shall be rounded down to the next whole number and the Company shall pay the Holder in cash the fair market value (based on the Closing Sale Price) for any such fractional shares.

13. **Notices.** Whenever notice is required to be given under this Warrant, including, without limitation, an Exercise Notice, unless otherwise provided herein, such notice shall be given in writing, (i) if delivered (a) from within the domestic United States, by first-class registered or certified airmail, or nationally recognized overnight express courier, postage prepaid, electronic mail or by facsimile or (b) from outside the United States, by International Federal Express, electronic mail or facsimile, and (ii) will be deemed given (A) if delivered by first-class registered or certified mail domestic, three (3) Business Days after so mailed, (B) if delivered by nationally recognized overnight carrier, one (1) Business Day after so mailed, (C) if delivered by International Federal Express, two (2) Business Days after so mailed and (D) at the time of transmission, if delivered by electronic mail to the email address specified in this Section 13 prior to 5:00 p.m. (New York time) on a Trading Day, (E) the next Trading Day after the date of transmission, if delivered by electronic mail to the email address specified in this Section 13 on a day that is not a Trading Day or later than 5:00 p.m. (New York time) on any Trading Day and (F) if delivered by facsimile, upon electronic confirmation of delivery of such facsimile, and will be delivered and addressed as follows:

(i) If to the Company, to:

X4 Pharmaceuticals, Inc.
61 North Beacon Street, 4th Floor
Boston, MA 02134
Attention: Adam Mostafa
Email: adam.mostafa@x4pharma.com

with a copy (which shall not constitute notice) to:

Cooley LLP
55 Hudson Yards
New York, NY 10001
Attention: Daniel L. Goldberg
Email: dgoldberg@cooley.com

(ii) if to the Holder, at such address or other contact information delivered by the Holder to Company or as is on the books and records of the Company.

14. **Warrant Agent.** The Warrant Agent shall initially serve as warrant agent under this Warrant. Upon thirty (30) days' notice to the Holder, the Company may appoint a new warrant agent. Any corporation into which the Warrant Agent or any new warrant agent may be merged or any corporation resulting from any consolidation to which the Warrant Agent or any new warrant agent shall be a party or any corporation to which the Warrant Agent or any new warrant agent transfers substantially all of its corporate trust or shareholders services business shall be a successor warrant agent under this Warrant without any further act. Any such successor warrant agent shall promptly cause notice of its succession as warrant agent to be mailed (by first class mail, postage prepaid) to the Holder at the Holder's last address as shown on the Warrant Register.

15. Miscellaneous.

(a) No Rights as a Stockholder. Except as otherwise set forth in this Warrant, the Holder, solely in such Person's capacity as a holder of this Warrant, shall not be entitled to vote or receive dividends or be deemed the holder of share capital of the Company for any purpose, nor shall anything contained in this Warrant be construed to confer upon the Holder, solely in such Person's capacity as the Holder of this Warrant, any of the rights of a stockholder of the Company or any right to vote, give or withhold consent to any corporate action (whether any reorganization, issue of stock, reclassification of stock, consolidation, merger, amalgamation, conveyance or otherwise), receive notice of meetings, receive dividends or subscription rights, or otherwise, prior to the issuance to the Holder of the Warrant Shares which such Person is then entitled to receive upon the due exercise of this Warrant. In addition, nothing contained in this Warrant shall be construed as imposing any liabilities on the Holder to purchase any securities (upon exercise of this Warrant or otherwise) or as a stockholder of the Company, whether such liabilities are asserted by the Company or by creditors of the Company.

(b) Authorized Shares.

(i) Except and to the extent as waived or consented to by the Holder, the Company shall not by any action, including, without limitation, amending its certificate or articles of incorporation or through any reorganization, transfer of assets, consolidation, merger, dissolution, issue or sale of securities or any other voluntary action, avoid or seek to avoid the observance or performance of any of the terms of this Warrant, but will at all times in good faith assist in the carrying out of all such terms and in the taking of all such actions as may be necessary or appropriate to protect the rights of Holder as set forth in this Warrant against impairment. Without limiting the generality of the foregoing, the Company will (a) not increase the par value of any Warrant Shares above the amount payable therefor upon such exercise immediately prior to such increase in par value, (b) take all such action as may be necessary or appropriate in order that the Company may validly and legally issue fully paid and nonassessable Warrant Shares upon the exercise of this Warrant, and (c) use commercially reasonable efforts to obtain all such authorizations, exemptions or consents from any public regulatory body having jurisdiction thereof as may be necessary to enable the Company to perform its obligations under this Warrant.

(ii) Before taking any action which would result in an adjustment in the number of Warrant Shares for which this Warrant is exercisable or in the Exercise Price, the Company shall obtain all such authorizations or exemptions thereof, or consents thereto, as may be necessary from any public regulatory body or bodies having jurisdiction thereof.

(c) Successors and Assigns. Subject to compliance with applicable securities laws, this Warrant may be transferred or assigned by the Holder. This Warrant may not be assigned by the Company without the written consent of the Holder except to a successor in the event of a Fundamental Transaction. This Warrant shall be binding on and inure to the benefit of the Company and the Holder and their respective successors and assigns. Subject to the preceding sentence, nothing in this Warrant shall be construed to give to any Person other than the Company and the Holder any legal or equitable right, remedy or cause of action under this Warrant. This Warrant may be amended only in writing signed by the Company and the Holder, or their successors and assigns.

(d) Restrictions. The Holder acknowledges that the Warrant Shares acquired upon the exercise of this Warrant, if not registered and if the Holder does not utilize cashless exercise after expiration of the Rule 144 holding period, will contain a legend to the effect that the Warrant Shares are not registered.

(e) Amendment and Waiver. Except as otherwise provided herein, the provisions of the Warrants may be amended and the Company may take any action herein prohibited, or omit to perform any act herein required to be performed by it, only if the Company has obtained the written consent of the Holder.

(f) Acceptance. Receipt of this Warrant by the Holder shall constitute acceptance of and agreement to all of the terms and conditions contained herein.

(g) Governing Law; Jurisdiction. ALL QUESTIONS CONCERNING THE CONSTRUCTION, VALIDITY, ENFORCEMENT AND INTERPRETATION OF THIS WARRANT SHALL BE GOVERNED BY AND CONSTRUED AND ENFORCED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE WITHOUT REGARD TO THE PRINCIPLES OF CONFLICTS OF LAW THEREOF. EACH OF THE COMPANY AND THE HOLDER HEREBY IRREVOCABLY SUBMITS TO THE EXCLUSIVE JURISDICTION OF THE STATE AND FEDERAL COURTS SITTING IN THE STATE OF DELAWARE FOR THE ADJUDICATION OF ANY DISPUTE HEREUNDER OR IN CONNECTION HERewith OR WITH ANY TRANSACTION CONTEMPLATED HEREBY OR DISCUSSED HEREIN (INCLUDING WITH RESPECT TO THE ENFORCEMENT OF ANY OF THE TRANSACTION DOCUMENTS), AND HEREBY IRREVOCABLY WAIVES, AND AGREES NOT TO ASSERT IN ANY SUIT, ACTION OR PROCEEDING, ANY CLAIM THAT

IT IS NOT PERSONALLY SUBJECT TO THE JURISDICTION OF ANY SUCH COURT. EACH OF THE COMPANY AND THE HOLDER HEREBY IRREVOCABLY WAIVES PERSONAL SERVICE OF PROCESS AND CONSENTS TO PROCESS BEING SERVED IN ANY SUCH SUIT, ACTION OR PROCEEDING BY MAILING A COPY THEREOF VIA REGISTERED OR CERTIFIED MAIL OR OVERNIGHT DELIVERY (WITH EVIDENCE OF DELIVERY) TO SUCH PERSON AT THE ADDRESS IN EFFECT FOR NOTICES TO IT AND AGREES THAT SUCH SERVICE SHALL CONSTITUTE GOOD AND SUFFICIENT SERVICE OF PROCESS AND NOTICE THEREOF. NOTHING CONTAINED HEREIN SHALL BE DEEMED TO LIMIT IN ANY WAY ANY RIGHT TO SERVE PROCESS IN ANY MANNER PERMITTED BY LAW. EACH OF THE COMPANY AND THE HOLDER HEREBY WAIVES ALL RIGHTS TO A TRIAL BY JURY.

(h) Headings. The headings herein are for convenience only, do not constitute a part of this Warrant and shall not be deemed to limit or affect any of the provisions hereof.

(i) Severability. In case any one or more of the provisions of this Warrant shall be invalid or unenforceable in any respect, the validity and enforceability of the remaining terms and provisions of this Warrant shall not in any way be affected or impaired thereby, and the Company and the Holder will attempt in good faith to agree upon a valid and enforceable provision which shall be a commercially reasonable substitute therefor, and upon so agreeing, shall incorporate such substitute provision in this Warrant.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

IN WITNESS WHEREOF, the Company has caused this Pre-Funded Warrant to be duly executed as of the Original Issue Date set out above.

X4 PHARMACEUTICALS, INC.

By: _____
Name:
Title:

SCHEDULE 1

FORM OF EXERCISE NOTICE

[To be executed by the Holder to purchase shares of Common Stock under the Warrant]

X4 PHARMACEUTICALS, INC.

Ladies and Gentlemen:

(1) The undersigned is the Holder of Warrant No. [•] (the "Warrant") issued by X4 Pharmaceuticals, Inc., a Delaware corporation (the "Company"). Capitalized terms used herein and not otherwise defined herein have the respective meanings set forth in the Warrant.

(2) The undersigned hereby exercises its right to purchase Warrant Shares pursuant to the Warrant.

(3) The Holder intends that payment of the Exercise Price shall be made as (check one):

Cash Exercise

"Cashless Exercise" under Section 10 of the Warrant

(4) If the Holder has elected a Cash Exercise, the Holder shall pay the sum of \$ _____ in immediately available funds to the Company in accordance with the terms of the Warrant.

(5) Pursuant to this Exercise Notice, the Company shall deliver to the Holder Warrant Shares determined in accordance with the terms of the Warrant.

(6) By its delivery of this Exercise Notice, the undersigned represents and warrants to the Company that in giving effect to the exercise evidenced hereby the Holder will not beneficially own in excess of the number of shares of Common Stock (as determined in accordance with Section 13(d) of the Securities Exchange Act of 1934, as amended) permitted to be owned under Section 11(a) of the Warrant to which this notice relates.

Dated:

Name of Holder:

By: _____
Name: _____
Title: _____

(Signature must conform in all respects to name of Holder as specified on the face of the Warrant)

ACKNOWLEDGMENT

The Company hereby acknowledges this Exercise Notice and hereby directs Computershare Trust Company, N.A. to issue the above indicated number of shares of Common Stock on or prior to the applicable Share Delivery Date.

X4 PHARMACEUTICALS, INC.

By: _____
Name:
Title:

Schedule 2

ASSIGNMENT FORM

(To assign the foregoing Warrant, execute this form and supply required information. Do not use this form to purchase shares.)

FOR VALUE RECEIVED, the foregoing Warrant and all rights evidenced thereby are hereby assigned to
Name:

(Please Print)

Address:

(Please Print)

Phone Number:

Email Address:

Dated: ,

Holder's Signature:

Holder's Address:

SECURITIES PURCHASE AGREEMENT

This SECURITIES PURCHASE AGREEMENT (this “**Agreement**”) is made and entered into as of May 15, 2023, by and among X4 Pharmaceuticals, Inc., a Delaware corporation (the “**Company**”), and the Investors identified on **Exhibit A** attached hereto (each an “**Investor**” and collectively the “**Investors**”).

RECITALS

A. The Company and the Investors are executing and delivering this Agreement in reliance upon the exemption from securities registration afforded by the provisions of Section 4(a)(2) of the 1933 Act (as defined below);

B. The Investors wish to purchase from the Company, and the Company wishes to sell and issue to the Investors, upon the terms and subject to the conditions stated in this Agreement, shares (the “**Shares**”) of the Company’s Common Stock, par value \$0.001 per share (the “**Common Stock**”), and/or pre-funded warrants to purchase Common Stock in the form attached hereto as **Exhibit B** (the “**Pre-Funded Warrants**”); and

C. Contemporaneously with the sale of the Shares and the Pre-Funded Warrants, the parties hereto will execute and deliver a Registration Rights Agreement, in the form attached hereto as **Exhibit C** (the “**Registration Rights Agreement**”), pursuant to which the Company will agree to provide certain registration rights in respect of the Shares and the Warrant Shares (as defined below) under the 1933 Act and applicable state securities laws.

In consideration of the mutual promises made herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto agree as follows:

1. **Definitions.** For the purposes of this Agreement, the following terms shall have the meanings set forth below:

“**Affiliate**” means, with respect to any Person, any other Person which directly or indirectly through one or more intermediaries Controls, is controlled by, or is under common Control with such Person. For the avoidance of doubt, with respect to any Investor that is an investment fund or other investment vehicle, such Investor shall be deemed not to be an Affiliate of (i) any portfolio company of such Investor or its Affiliates or (ii) any limited partner of any such Investor or its Affiliates.

“**Board**” means the board of directors of the Company.

“**Business Day**” means a day, other than a Saturday or Sunday, on which banks in New York City are open for the general transaction of business.

“**Closing**” has the meaning set forth in Section 3.1.

“**Closing Date**” has the meaning set forth in Section 3.1.

“**Closing Securities**” means the Shares and the Pre-Funded Warrants sold at Closing.

“**Common Stock**” has the meaning set forth in the recitals to this Agreement.

“**Intellectual Property**” has the meaning set forth in Section 4.14.

“**Company’s Knowledge**” means the actual knowledge of the executive officers (as defined in Rule 405 under the 1933 Act) of the Company.

“**Control**” (including the terms “controlling,” “controlled by” or “under common control with”) means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a Person, whether through the ownership of voting securities, by contract or otherwise.

“**EDGAR system**” has the meaning set forth in Section 4.9.

“**Environmental Laws**” has the meaning set forth in Section 4.15.

“GAAP” has the meaning set forth in Section 4.17.

“Governmental Entity” means any national, federal, state, municipal, local, territorial, foreign or other government or any department, commission, board, bureau, agency, regulatory authority or instrumentality thereof, or any court, judicial, administrative or arbitral body or public or private tribunal.

“HSR Act” has the meaning set forth in Section 7.9.

“Investor Questionnaire” has the meaning set forth in Section 5.8.

“Material Adverse Effect” means a material adverse effect on (i) the assets, liabilities, results of operations, financial condition or business of the Company and its subsidiaries taken as a whole, (ii) the legality or enforceability of any of the Transaction Documents or (iii) the ability of the Company to perform its obligations under the Transaction Documents, except that for purposes of Section 6.1(i) of this Agreement, in no event shall a change in the market price of the Common Stock alone constitute a “Material Adverse Effect”.

“Material Contract” means any contract, instrument or other agreement to which the Company is a party or by which it is bound that has been filed or was required to have been filed as an exhibit to the SEC Filings pursuant to Item 601(b)(4) or Item 601(b)(10) of Regulation S-K.

“Nasdaq” means the Nasdaq Stock Market LLC.

“Person” means an individual, corporation, partnership, limited liability company, trust, business trust, association, joint stock company, joint venture, sole proprietorship, unincorporated organization, governmental authority or any other form of entity not specifically listed herein.

“Placement Agents” shall mean Piper Sandler & Co. and Stifel, Nicolaus & Company, Incorporated.

“Pre-Funded Warrants” has the meaning set forth in the recitals to this Agreement.

“Principal Trading Market” means the Trading Market on which the Common Stock is primarily listed on and quoted for trading, which, as of the date of this Agreement and the Closing Date, shall be the Nasdaq Capital Market.

“Prior Registration Rights Agreements” means (1) that certain Registration Rights Agreement, dated March 18, 2021, by and among the Company and the investors identified therein, (2) that certain Registration Rights Agreement, dated November 5, 2021, by and among the Company and the investors identified therein, (3) that certain Registration Rights Agreement, dated January 14, 2022, by and between the Company and Lincoln Park Capital Fund, LLC, (4) that certain Registration Rights Agreement, dated March 3, 2022, by and among the Company and the investors identified therein, and (5) that certain Registration Rights Agreement, dated June 30, 2022, by and among the Company and the investors identified therein.

“Public Disclosure” has the meaning set forth in Section 9.7.

“Registration Rights Agreement” has the meaning set forth in the recitals to this Agreement.

“Regulatory Authorities” has the meaning set forth in Section 4.30.

“Required Investors” has the meaning set forth in the Registration Rights Agreement.

“SEC” means the U.S. Securities and Exchange Commission.

“SEC Filings” has the meaning set forth in Section 4.8.

“Securities” means the Shares, the Pre-Funded Warrants and the Warrant Shares, as applicable.

“Shares” has the meaning set forth in the recitals to this Agreement.

“Short Sales” means all “short sales” as defined in Rule 200 of Regulation SHO under the 1934 Act (but shall not be deemed to include the location and/or reservation of borrowable shares of Common Stock).

“**Trading Day**” means (i) a day on which the Common Stock is listed or quoted and traded on its Principal Trading Market (other than the OTC Bulletin Board), or (ii) if the Common Stock is not listed on a Trading Market (other than the OTC Bulletin Board), a day on which the Common Stock is traded in the over-the-counter market, as reported by the OTC Bulletin Board, or (iii) if the Common Stock is not quoted on any Trading Market, a day on which the Common Stock is quoted in the over-the-counter market as reported in the “pink sheets” by OTC Markets Group Inc. (or any similar organization or agency succeeding to its functions of reporting prices); provided, that in the event that the Common Stock is not listed or quoted as set forth in (i), (ii) or (iii) hereof, then Trading Day shall mean a Business Day.

“**Trading Market**” means whichever of the New York Stock Exchange, the NYSE American, the Nasdaq Global Select Market, the Nasdaq Global Market, the Nasdaq Capital Market or the OTC Bulletin Board on which the Common Stock is listed or quoted for trading on the date in question.

“**Transfer Agent**” has the meaning set forth in Section 7.2.

“**Transaction Documents**” means this Agreement, the Pre-Funded Warrants and the Registration Rights Agreement.

“**Warrant Shares**” means the shares of Common Stock issuable upon exercise of the Pre-Funded Warrants.

“**1933 Act**” means the Securities Act of 1933, as amended, or any successor statute, and the rules and regulations promulgated thereunder.

“**1934 Act**” means the Securities Exchange Act of 1934, as amended, or any successor statute, and the rules and regulations promulgated thereunder.

2. Purchase and Sale of the Securities. On the Closing Date, upon the terms and subject to the conditions set forth herein, the Company will issue and sell, and each Investor will purchase, severally and not jointly, (A) the number of Shares set forth opposite the name of such Investor under the heading “Number of Shares” on **Exhibit A** attached hereto and (B) a Pre-Funded Warrant to purchase the number of Warrant Shares set forth opposite the name of such Investor under the heading “Number of Warrant Shares Underlying Pre-Funded Warrant” on **Exhibit A** attached hereto, if any. The purchase price per Share shall be \$1.52. The purchase price per Pre-Funded Warrant shall be \$1.519. The Pre-Funded Warrants shall have an exercise price equal to \$0.001 per Warrant Share.

3. Closing.

3.1 Upon the satisfaction of the conditions set forth in Section 6, the completion of the purchase and sale of the Closing Securities (the “**Closing**”) shall occur remotely via exchange of documents and signatures on May 18, 2023 (the “**Closing Date**”).

3.2 On the Closing Date, each Investor shall deliver or cause to be delivered to the Company, via wire transfer of immediately available funds pursuant to the wire instructions delivered to such Investor by the Company on or prior to the Closing Date, an amount equal to the purchase price to be paid by the Investor for the Closing Securities to be acquired by it as set forth opposite the name of such Investor under the heading “Aggregate Purchase Price of Securities” on **Exhibit A** attached hereto.

3.3 At the Closing, the Company shall deliver or cause to be delivered to each Investor (A) a number of Shares, registered in the name of the Investor (or its nominee in accordance with its delivery instructions), equal to the number of Shares set forth opposite the name of such Investor under the heading “Number of Shares” on **Exhibit A** attached hereto and (B) a Pre-Funded Warrant, registered in the name of the Investor (or its nominee in accordance with its delivery instructions), to purchase up to the number of Warrant Shares set forth opposite the name of such Investor under the heading “Number of Warrant Shares Underlying Pre-Funded Warrant” on **Exhibit A** attached hereto, if any. The Shares shall be delivered via a book-entry record through the Transfer Agent and, as soon as practicable thereafter, the Company shall provide a copy of the records of the Transfer Agent showing the Investor as the owner of the Shares on and as of the Closing Date. Unless the Company and an Investor otherwise mutually agree with respect to such Investor’s Shares, at Closing settlement shall occur on a “delivery versus payment” basis.

4. Representations and Warranties of the Company. The Company hereby represents and warrants to the Investors as of the date hereof and as of the Closing Date that, except as described in the Company’s SEC Filings, each of which qualify these representations and warranties in their entirety:

4.1 Organization, Good Standing and Qualification. The Company is a corporation duly organized, validly existing and in good standing under the laws of the jurisdiction of its incorporation and has all requisite corporate power and authority to carry on its business as now conducted and to own or lease its properties. The Company is duly qualified to do business as a foreign corporation and is in good standing in each jurisdiction in which the conduct of its business or its ownership or leasing of property makes such qualification or leasing necessary unless the failure to so qualify has not had and would not reasonably be expected to have a Material Adverse Effect. X4 Pharmaceuticals Securities Corporation, a Massachusetts corporation; X4 Pharmaceuticals, Inc., a Delaware corporation; X4 Pharmaceuticals (Austria) GmbH, a company incorporated under the laws of Austria; and X4 Therapeutics Inc., a Delaware corporation, are the only subsidiaries of the Company and are wholly-owned by the Company. Each subsidiary of the Company has been duly incorporated or organized and is validly existing and in good standing (or such equivalent concepts to the extent they exist under the law of such jurisdiction) under the laws of the jurisdiction of its incorporation or organization, and have all requisite power and authority to carry on their business as now conducted and to own or lease their properties. The Company's subsidiaries are duly qualified to do business and are in good standing (or such equivalent concept to the extent it exists under the law of such jurisdiction) in each jurisdiction in which the conduct of their business or their ownership or leasing of property makes such qualification necessary unless the failure to so qualify has not had and would not reasonably be expected to have a Material Adverse Effect. Neither the Company nor any subsidiary is in violation nor default of any of the provisions of its respective certificate or articles of incorporation, bylaws or other organizational or charter documents.

4.2 Authorization. The Company has the requisite corporate power and authority and has taken all requisite corporate action necessary for, and no further action on the part of the Company, its officers, directors and stockholders is necessary for, (i) the authorization, execution and delivery of the Transaction Documents, (ii) the authorization of the performance of all obligations of the Company hereunder or thereunder, and (iii) the authorization, issuance (or reservation for issuance) and delivery of the Securities. The Transaction Documents constitute the legal, valid and binding obligations of the Company, enforceable against the Company in accordance with their terms, subject to bankruptcy, insolvency, fraudulent transfer, reorganization, moratorium and similar laws of general applicability, relating to or affecting creditors' rights generally and to general equitable principles.

4.3 Capitalization. The Company is authorized under its certificate of incorporation (the "**Certificate of Incorporation**") to issue 500,000,000 shares of Common Stock. The Company's disclosure of its issued and outstanding capital stock in its most recent SEC Filing containing such disclosure was accurate in all material respects as of the date indicated in such SEC Filing. Since the date indicated in such SEC Filing, there has not been any change in the Company's capital stock, other than as a result of the exercise of stock options or the award of stock options or restricted stock units in the ordinary course of business pursuant to the Company's stock-based compensation plans described in the SEC Filings. All of the issued and outstanding shares of the Company's capital stock have been duly authorized and validly issued and are fully paid and nonassessable; none of such shares were issued in violation of any preemptive rights; and such shares were issued in compliance in all material respects with applicable state and federal securities law and any rights of third parties. No Person is entitled to preemptive or similar statutory or contractual rights with respect to the issuance by the Company of any securities of the Company, including, without limitation, the Securities. Except for stock options and restricted stock units approved pursuant to Company stock-based compensation plans described in the SEC Filings, warrants and prefunded warrants described in the SEC Filings, and other agreements described in the SEC Filings, there are no outstanding warrants, options, convertible securities or other rights, agreements or arrangements of any character under which the Company is or may be obligated to issue any equity securities of any kind, except as contemplated by this Agreement. Except for the Registration Rights Agreement and the Prior Registration Rights Agreements, there are no voting agreements, buy-sell agreements, option or right of first purchase agreements or other agreements of any kind among the Company and any of the securityholders of the Company relating to the securities of the Company held by them. Except as provided in the Registration Rights Agreement and the Prior Registration Rights Agreements, and except for registration rights granted to holders of the Company's Class A Warrants and Class C Warrants, which requires the Company to file a separate registration statement to register the issuance of shares of Common Stock underlying the Class A Warrants and Class C Warrants, no Person has the right to require the Company to register any securities of the Company under the 1933 Act, whether on a demand basis or in connection with the registration of securities of the Company for its own account or for the account of any other Person that have not otherwise been satisfied in full.

The issuance and sale of the Securities hereunder will not obligate the Company to issue shares of Common Stock or other securities to any other Person (other than the Investors) and, except as described in the SEC Filings, will not result in the adjustment of the exercise, conversion, exchange or reset price of any outstanding security.

The Company does not have outstanding stockholder purchase rights or "poison pill" or any similar arrangement in effect giving any Person the right to purchase any equity interest in the Company upon the occurrence of certain events.

4.4 Valid Issuance. The Shares have been duly and validly authorized and, when issued and paid for pursuant to this Agreement, will be validly issued, fully paid and nonassessable, and shall be free and clear of all encumbrances and restrictions (other than those created by the Investors), except for restrictions on transfer set forth in the Transaction Documents or imposed by applicable securities laws. The Warrant Shares have been duly and validly authorized and reserved for issuance and, upon exercise of the Pre-Funded Warrants in accordance with their terms, including the payment of any exercise price therefor, will be validly issued, fully paid and nonassessable and will be free and clear of all encumbrances and restrictions (other than those created by the Investors), except for restrictions on transfer set forth in the Transaction Documents or imposed by applicable securities laws. Assuming the accuracy of the representations and warranties of each Investor in Section 5 hereof, the Warrant Shares will be issued in compliance with all applicable federal and state securities laws.

4.5 Consents. Subject to the accuracy of the representations and warranties of each Investor set forth in Section 5 hereof, the execution, delivery and performance by the Company of the Transaction Documents and the offer, issuance and sale of the Securities require no consent of, action by or in respect of, or filing with, any Person, governmental body, agency, or official, including, without limitation, any consent, action by, or approval of shareholders of the Company, other than (a) filings that have been made pursuant to applicable state securities laws, (b) post-sale filings pursuant to applicable state and federal securities laws, (c) filings pursuant to the rules and regulations of Nasdaq and (d) filing of the registration statement required to be filed by the Registration Rights Agreement, each of which the Company has filed or undertakes to file within the applicable time. Subject to the accuracy of the representations and warranties of each Investor set forth in Section 5 hereof, the Company has taken all action necessary to exempt (i) the issuance and sale of the Securities and (ii) the other transactions contemplated by the Transaction Documents from the provisions of any stockholder rights plan or other "poison pill" arrangement, any anti-takeover, business combination or control share law or statute binding on the Company or to which the Company or any of its assets and properties is subject that is or could reasonably be expected to become applicable to the Investors as a result of the transactions contemplated hereby, including without limitation, the issuance of the Securities and the ownership, disposition or voting of the Shares or the Warrant Shares by the Investors or the exercise of any right granted to the Investors pursuant to this Agreement or the other Transaction Documents.

4.6 Use of Proceeds. The net proceeds of the sale of the Securities hereunder shall be used by the Company for advancement of the Company's clinical development pipeline, business development activities, working capital and general corporate purposes.

4.7 No Material Adverse Change. Since March 31, 2023, except as identified and described in the SEC Filings filed at least one Trading Day prior to the date hereof, there has not been:

(i) any change in the consolidated assets, liabilities, financial condition or operating results of the Company from that reflected in the financial statements included in the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2023, except for changes in the ordinary course of business which have not had and would not reasonably be expected to have a Material Adverse Effect, individually or in the aggregate;

(ii) any declaration or payment by the Company of any dividend, or any authorization or payment by the Company of any distribution, on any of the capital stock of the Company, or any redemption or repurchase by the Company of any securities of the Company;

(iii) any material damage, destruction or loss, whether or not covered by insurance, to any assets or properties of the Company;

(iv) any waiver, not in the ordinary course of business, by the Company of a material right or of a material debt owed to it;

(v) any satisfaction or discharge of any lien, claim or encumbrance or payment of any obligation by the Company, except in the ordinary course of business and which is not material to the assets, properties, financial condition, operating results or business of the Company (as such business is presently conducted);

(vi) any change or amendment to the Company's Certificate of Incorporation or Bylaws, or material change to any material contract or arrangement by which the Company is bound or to which any of its assets or properties is subject;

(vii) any material labor difficulties or, to the Company's Knowledge, labor union organizing activities with respect to employees of the Company;

(viii) any material transaction entered into by the Company other than in the ordinary course of business;

(ix) the loss of the services of any key employee, or material change in the composition or duties of the senior management of the Company; or

(x) any other event or condition of any character that has had or would reasonably be expected to have a Material Adverse Effect.

4.8 SEC Filings. The Company has timely filed all reports, schedules, forms, statements and other documents required to be filed by the Company under the 1933 Act and the 1934 Act, including pursuant to Section 13(a) or 15(d) thereof, for the one year period preceding the date hereof (collectively, the “**SEC Filings**”). At the time of filing thereof, the SEC Filings complied in all material respects with the requirements of the 1933 Act or the 1934 Act, as applicable, and the rules and regulations of the SEC thereunder and did not contain any untrue statement of a material fact or omit to state any material fact required to be stated therein or necessary in order to make the statements made therein, in the light of the circumstances under which they were made, not misleading.

4.9 No Conflict, Breach, Violation or Default. The execution, delivery and performance of the Transaction Documents by the Company and the issuance and sale of the Securities in accordance with the provisions thereof will not, except (solely in the case of clause (i)(b) and clause (ii)) for such violations, conflicts or defaults as would not reasonably be expected, individually or in the aggregate, to have a Material Adverse Effect, (i) conflict with or result in a breach or violation of (a) any of the terms and provisions of, or constitute a default under, the Company’s Certificate of Incorporation or the Company’s Bylaws, both as in effect on the date hereof (true and complete copies of which have been made available to the Investors through the Electronic Data Gathering, Analysis, and Retrieval system (the “**EDGAR system**”)), or (b) assuming the accuracy of the representations and warranties in Section 5, any applicable statute, rule, regulation or order of any governmental agency or body or any court, domestic or foreign, having jurisdiction over the Company or its subsidiaries, or any of their assets or properties, or (ii) conflict with, or constitute a default (or an event that with notice or lapse of time or both would become a default) under, result in the creation of any lien, encumbrance or other adverse claim upon any of the properties or assets of the Company or its subsidiaries or, except as disclosed in the SEC Filings, give to others any rights of termination, amendment, acceleration or cancellation (with or without notice, lapse of time or both) of, any Material Contract. This Section 4.9 does not relate to matters with respect to tax status, which are the subject of Section 4.10, employee relations and labor matters, which are the subject of Section 4.13, or environmental laws, which are the subject of Section 4.15.

4.10 Tax Matters. The Company and its subsidiaries have timely prepared and filed all material tax returns required to have been filed by them with all appropriate governmental agencies and timely paid all material taxes shown thereon or otherwise owed by them. There are no material unpaid assessments against the Company nor, to the Company’s Knowledge, any audits by any federal, state or local taxing authority. All material taxes that the Company is required to withhold or to collect for payment have been duly withheld and collected and paid to the proper governmental entity or third party when due. There are no tax liens pending or, to the Company’s Knowledge, threatened against the Company or any of its assets or property. With the exception of agreements or other arrangements that are not primarily related to taxes entered into in the ordinary course of business, there are no outstanding tax sharing agreements or other such arrangements between the Company and any other corporation or entity (other than a subsidiary of the Company).

4.11 Title to Properties. The Company and its subsidiaries have good and marketable title to all real properties and all other material properties and assets owned by them, in each case free from liens, encumbrances and defects, except such as would not reasonably be expected, individually or in the aggregate, to have a Material Adverse Effect; and the Company and its subsidiaries hold any leased real or personal property under valid and enforceable leases with no exceptions, except such as would not reasonably be expected, individually or in the aggregate, to have a Material Adverse Effect.

4.12 Certificates, Authorities and Permits. The Company possesses adequate certificates, authorities or permits issued by appropriate governmental agencies or bodies necessary to conduct the business now operated by it, except where failure to so possess would not reasonably be expected, individually or in the aggregate, to result in a Material Adverse Effect. The Company has not received any written notice of proceedings relating to the revocation or modification of any such certificate, authority or permit that would reasonably be expected to have a Material Adverse Effect, individually or in the aggregate, on the Company.

4.13 Labor Matters.

(a) The Company is not party to or bound by any collective bargaining agreements or other agreements with labor organizations. To the Company’s Knowledge, the Company has not violated in any material respect any laws, regulations, orders or contract terms affecting the collective bargaining rights of employees or labor organizations,

or any laws, regulations or orders affecting employment discrimination, equal opportunity employment, or employees' health, safety, welfare, wages and hours.

(b) No material labor dispute with the employees of the Company, or with the employees of any principal supplier, manufacturer, customer or contractor of the Company, exists or, to the Company's Knowledge, is threatened or imminent.

4.14 Intellectual Property. The Company owns, possesses, licenses or has other rights to use, all patents, patent applications, trade and service marks, trade and service mark registrations, trade names, copyrights, licenses, inventions, trade secrets, technology, know-how and other intellectual property that are described in the SEC Filings (collectively, the "**Intellectual Property**"); and to the Company's Knowledge, no additional third party intellectual property rights are necessary for the conduct of the Company's business in all material respects as now conducted or as proposed in the SEC Filings to be conducted; and (a) except as described in the SEC filings, there are no rights of third parties to any such Intellectual Property, including no liens, security interests or other encumbrances; (b) to the Company's Knowledge, there is no material infringement by third parties of any such Intellectual Property; (c) there is no pending or, to the Company's Knowledge, threatened action, suit, proceeding or claim by others challenging the Company's or its subsidiaries' rights in or to any such Intellectual Property, and the Company is unaware of any facts, which could form a reasonable basis for any such action, suit, proceeding or claim; (d) such Intellectual Property that is described in the SEC Filings has not been adjudged by a court of competent jurisdiction invalid or unenforceable, in whole or in part; (e) there is no pending or, to the Company's Knowledge, threatened action, suit, proceeding or claim by others challenging the validity or scope of any such Intellectual Property that is owned or licensed by the Company, including interferences, oppositions, reexaminations or government proceedings; (f) there is no pending or, to the Company's Knowledge, threatened action, suit, proceeding or claim by others that the Company and its subsidiaries infringe, misappropriate, or otherwise violate any patent, trademark, copyright, trade secret or other proprietary rights of others; (g) to the Company's Knowledge, there is no third-party U.S. patent or published U.S. patent application which contains claims for which an Interference Proceeding (as defined in 35 U.S.C. § 135) has been commenced against any patent or patent application described in the SEC Filings as being owned by or licensed to the Company; (h) to the Company's Knowledge, the Company and its subsidiaries have complied with the terms of each agreement pursuant to which Intellectual Property has been licensed to the Company or such subsidiary, and all such agreements are in full force and effect; and (i) each key employee of the Company and each Company employee involved with the development of Intellectual Property has entered into an invention assignment agreement with the Company.

4.15 Environmental Matters. The Company is not in violation of any statute, rule, regulation, decision or order of any governmental agency or body or any court, domestic or foreign, relating to the use, disposal or release of hazardous or toxic substances or relating to the protection or restoration of the environment or human exposure to hazardous or toxic substances (collectively, "**Environmental Laws**"), has not released any hazardous substances regulated by Environmental Law onto any real property that it owns or operates, and has not received any written notice or claim it is liable for any off-site disposal or contamination pursuant to any Environmental Laws, which violation, release, notice, claim, or liability would reasonably be expected, individually or in the aggregate, to have a Material Adverse Effect, and to the Company's Knowledge, there is no pending or threatened investigation that would reasonably be expected to lead to such a claim.

4.16 Legal Proceedings. There are no legal, governmental or regulatory investigations, actions, suits or proceedings pending, or to the Company's Knowledge, threatened to which the Company or its subsidiaries are a party or to which any property of the Company or its subsidiaries are the subject that, individually or in the aggregate, would reasonably be expected to have a Material Adverse Effect.

4.17 Financial Statements. The financial statements included in each SEC Filing comply in all material respects with applicable accounting requirements and the rules and regulations of the SEC with respect thereto as in effect at the time of filing (or to the extent corrected by a subsequent restatement) and present fairly, in all material respects, the consolidated financial position of the Company as of the dates shown and its consolidated results of operations and cash flows for the periods shown, subject in the case of unaudited financial statements to normal, immaterial year-end audit adjustments, and such consolidated financial statements have been prepared in conformity with United States generally accepted accounting principles applied on a consistent basis during the periods involved ("**GAAP**") (except as may be disclosed therein or in the notes thereto, and except that the unaudited financial statements may not contain all footnotes required by GAAP, and, in the case of quarterly financial statements, except as permitted by Form 10-Q under the 1934 Act). Except as set forth in the financial statements of the Company included in the SEC Filings or as otherwise disclosed in the SEC Filings filed prior to the date hereof, the Company has not incurred any liabilities, contingent or otherwise, except those incurred in the ordinary course of business, consistent (as to amount and nature) with past practices since the date of such financial statements, none of which, individually or in the aggregate, have had or would reasonably be expected to have a Material Adverse Effect.

4.18 Insurance Coverage. The Company maintains in full force and effect insurance coverage that is customary for comparably situated companies for the business being conducted and properties owned or leased by the Company, and the Company reasonably believes such insurance coverage to be adequate against all liabilities, claims and risks against which it is customary for comparably situated companies to insure.

4.19 Compliance with Nasdaq Continued Listing Requirements. The Company is in compliance with applicable Nasdaq continued listing requirements. There are no proceedings pending or, to the Company's Knowledge, threatened against the Company relating to the continued listing of the Common Stock on Nasdaq and the Company has not received any notice of, nor to the Company's Knowledge is there any reasonable basis for, the delisting of the Common Stock from Nasdaq.

4.20 Brokers and Finders. Except for commissions and fees payable by the Company to the Placement Agents pursuant to an engagement letter between the Company and Placement Agents, no Person will have, as a result of the transactions contemplated by the Transaction Documents, any valid right, interest or claim against or upon the Company or an Investor for any commission, fee or other compensation pursuant to any agreement, arrangement or understanding entered into by or on behalf of the Company. No Investor shall have any obligation with respect to any fees, or with respect to any claims made by or on behalf of other Persons for fees, in each case of the type contemplated by this Section 4.20 that may be due in connection with the transactions contemplated by this Agreement or the Transaction Documents.

4.21 No Directed Selling Efforts or General Solicitation. Neither the Company nor any Person acting on its behalf has conducted any general solicitation or general advertising in connection with the offer or sale of any of the Securities.

4.22 No Integrated Offering. Neither the Company nor its subsidiaries nor any Person acting on their behalf has, directly or indirectly, made any offers or sales of any Company security or solicited any offers to buy any Company security, under circumstances that would adversely affect reliance by the Company on Section 4(a)(2) for the exemption from registration for the transactions contemplated hereby or would require registration of the Securities under the 1933 Act.

4.23 Private Placement. Assuming the accuracy of the representations and warranties of the Investors set forth in Section 5, the offer and sale of the Closing Securities to the Investors and the exercise of the Pre-Funded Warrants as contemplated hereby are exempt from the registration requirements of the 1933 Act pursuant to Section 4(a)(2). The issuance and sale of the Closing Securities and the exercise of the Pre-Funded Warrants do not contravene the rules and regulations of Nasdaq.

4.24 Questionable Payments. Neither the Company nor its subsidiaries nor, to the Company's Knowledge, any of their current or former directors, officers, employees, agents or other Persons acting on behalf of the Company or its subsidiaries, has on behalf of the Company or its subsidiaries in connection with their business: (a) used any corporate funds for unlawful contributions, gifts, entertainment or other unlawful expenses relating to political activity; (b) made any direct or indirect unlawful payments to any governmental officials or employees from corporate funds; (c) established or maintained any unlawful or unrecorded fund of corporate monies or other assets which is in violation of law; (d) made any false or fictitious entries on the books and records of the Company; or (e) made any unlawful bribe, rebate, payoff, influence payment, kickback or other unlawful payment of any nature.

4.25 Transactions with Affiliates. None of the executive officers or directors of the Company and, to the Company's Knowledge, none of the employees of the Company is presently a party to any transaction with the Company (other than as holders of stock options, restricted stock units, warrants and/or restricted stock, and for services as employees, officers and directors), including any contract, agreement or other arrangement providing for the furnishing of services to or by, providing for rental of real or personal property to or from, or otherwise requiring payments to or from any officer, director or such employee or, to the Company's Knowledge, any entity in which any officer, director, or any such employee has a substantial interest or is an officer, director, trustee or partner.

4.26 Internal Controls. The Company has established and maintains disclosure controls and procedures (as defined in Rules 13a-15 and 15d-15 under the 1934 Act), which (a) are designed to ensure that material information relating to the Company, including its subsidiaries, is made known to the Company's principal executive officer and its principal financial officer by others within those entities; (b) have been evaluated by management of the Company for effectiveness as of the end of the Company's most recent fiscal quarter; and (c) are effective in all material respects to perform the functions for which they were established. Since the end of the Company's most recent audited fiscal year, there have been no material weaknesses in the Company's internal control over financial reporting (whether or not remediated) and no change in the Company's internal control over financial reporting that has materially affected, or would reasonably be expected to materially affect, the Company's internal control over financial reporting. The Company is not aware of any change in its internal controls over financial reporting that has

occurred during its most recent fiscal quarter that has materially affected, or would reasonably be expected to materially affect, the Company's internal control over financial reporting.

4.27 Disclosures. Neither the Company nor any Person acting on its behalf has provided the Investors or their agents or counsel with any information that constitutes or would reasonably be expected to constitute material nonpublic information concerning the Company or its subsidiaries, other than with respect to the transactions contemplated hereby, which will be disclosed in the Public Disclosure (as defined below). The SEC Filings do not contain any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements contained therein, in light of the circumstances under which they were made, not misleading. The Company understands and confirms that the Investors will rely on the foregoing representations in effecting transactions in securities of the Company.

4.28 Required Filings. Except for the Company's 4WHIM Phase 3 data being disclosed on May 16, 2023 after close of market and the transactions contemplated by this Agreement, including the acquisition of the Securities contemplated hereby, no event or circumstance has occurred or information exists with respect to the Company or its business, properties, operations or financial condition, which, under applicable law, rule or regulation, requires public disclosure or announcement by the Company but which has not been so publicly announced or disclosed.

4.29 Investment Company. The Company is not required to be registered as, and immediately following the Closing will not be required to register as, an "investment company" within the meaning of the Investment Company Act of 1940, as amended.

4.30 Tests and Preclinical and Clinical Trials. (i) The preclinical studies and clinical trials conducted by or on behalf of or sponsored by the Company or its subsidiaries, or in which the Company or its subsidiaries have participated, that are described in the SEC Filings, or the results of which are referred to in the SEC Filings, as applicable, were, and if still pending are, being conducted in all material respects in accordance with standard medical and scientific research standards and procedures for products or product candidates comparable to those being developed by the Company and all applicable statutes and all applicable rules and regulations of the U.S. Food and Drug Administration and comparable regulatory agencies outside of the United States to which they are subject, including the European Medicines Agency (collectively, the "**Regulatory Authorities**") and Good Clinical Practice and Good Laboratory Practice requirements; (ii) the descriptions in the SEC Filings of the results of such studies and trials are accurate and complete descriptions in all material respects and fairly present the data derived therefrom; (iii) to the Company's Knowledge, there are no other studies or trials not described in the SEC Filings, the results of which the Company believes are inconsistent with or reasonably call into question the results described or referred to in the SEC Filings; (iv) the Company and its subsidiaries have operated at all times and are currently in compliance with all applicable statutes, rules and regulations of the Regulatory Authorities, except where such non-compliance would not, individually or in the aggregate, have a Material Adverse Effect; and (v) neither the Company nor any of its subsidiaries have received any written notices, correspondence or other communications from the Regulatory Authorities or any other governmental agency requiring or threatening the termination, material modification or suspension of any preclinical studies or clinical trials that are described in the SEC Filings or the results of which are referred to in the SEC Filings, other than ordinary course communications with respect to modifications in connection with the design and implementation of such studies or trials.

4.31 Manipulation of Price. The Company has not taken, and, to the Company's Knowledge, no Person acting on its behalf has taken, directly or indirectly, any action designed to cause or to result in the stabilization or manipulation of the price of any security of the Company to facilitate the sale or resale of any of the Securities.

4.32 Anti-Bribery and Anti-Money Laundering Laws. Each of the Company, its subsidiaries and any of their respective officers, directors, supervisors, managers, agents, or employees, are and have at all times been in compliance with and its participation in the offering will not violate: (A) anti-bribery laws, including but not limited to, any applicable law, rule, or regulation of any locality, including but not limited to any law, rule, or regulation promulgated to implement the OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions, signed December 17, 1997, including the U.S. Foreign Corrupt Practices Act of 1977, as amended, the U.K. Bribery Act 2010, or any other law, rule or regulation of similar purposes and scope or (B) anti-money laundering laws, including, but not limited to, applicable federal, state, international, foreign or other laws, regulations or government guidance regarding anti-money laundering, including, without limitation, Title 18 US. Code sections 1956 and 1957, the Patriot Act, the Bank Secrecy Act, and international anti-money laundering principles or procedures by an intergovernmental group or organization, such as the Financial Action Task Force on Money Laundering, of which the United States is a member and with which designation the United States representative to the group or organization continues to concur, all as amended, and any Executive order, directive, or regulation pursuant to the authority of any of the foregoing, or any orders or licenses issued thereunder.

4.33 No Additional Agreements. Other than this Agreement and the Registration Rights Agreement, the Company has not entered into any other agreement or understanding (including, without limitation, side letters) with any Investor to purchase Securities or on terms more favorable to such Investor than as set forth herein.

4.34 Shell Company Status. The Company is not, and has never been, an issuer identified in Rule 144(i)(1).

4.35 Compliance. The Company is not (i) in default under or in violation of (and no event has occurred that has not been waived that, with notice or lapse of time or both, would result in a default by the Company under), nor has the Company received notice of a claim that it is in default under or that it is in violation of, any indenture, loan or credit agreement or any other agreement or instrument to which it is a party or by which it or any of its properties is bound (whether or not such default or violation has been waived) or (ii) in violation of any judgment, decree or order of any court, arbitrator or governmental body, except in each case as could not have or reasonably be expected to result in a Material Adverse Effect.

4.36 Reliance on Representations and Warranties. The Company acknowledges and agrees that the Placement Agents are entitled to rely on the accuracy of these representations.

5. Representations and Warranties of the Investors. Each of the Investors hereby severally, and not jointly, represents and warrants to the Company that:

5.1 Organization and Existence. Such Investor is a duly incorporated or organized and validly existing corporation, limited partnership, limited liability company or other legal entity, has all requisite corporate, partnership or limited liability company power and authority to enter into and consummate the transactions contemplated by the Transaction Documents and to carry out its obligations hereunder and thereunder, and to invest in the Securities pursuant to this Agreement, and is in good standing under the laws of the jurisdiction of its incorporation or organization.

5.2 Authorization. The execution, delivery and performance by such Investor of the Transaction Documents to which such Investor is a party have been duly authorized and each has been duly executed and when delivered will constitute the valid and legally binding obligation of such Investor, enforceable against such Investor in accordance with their respective terms, subject to bankruptcy, insolvency, fraudulent transfer, reorganization, moratorium and similar laws of general applicability, relating to or affecting creditors' rights generally, and general principles of equity.

5.3 Purchase Entirely for Own Account. The Securities to be received by such Investor hereunder will be acquired for such Investor's own account, not as nominee or agent, for the purpose of investment and not with a view to the resale or distribution of any part thereof in violation of the 1933 Act, and such Investor has no present intention of selling, granting any participation in, or otherwise distributing the same in violation of the 1933 Act without prejudice, however, to such Investor's right at all times to sell or otherwise dispose of all or any part of such Securities in compliance with applicable federal and state securities laws. The Securities are being purchased by such Investor in the ordinary course of its business. Nothing contained herein shall be deemed a representation or warranty by such Investor to hold the Securities for any period of time. Such Investor is not a broker-dealer registered with the SEC under the 1934 Act or an entity engaged in a business that would require it to be so registered.

5.4 Investment Experience. Such Investor acknowledges that it can bear the economic risk and complete loss of its investment in the Securities and has such knowledge and experience in financial or business matters that it is capable of evaluating the merits and risks of the investment contemplated hereby.

5.5 Disclosure of Information. Such Investor has had an opportunity to receive, review and understand all information related to the Company requested by it and to ask questions of and receive answers from the Company regarding the Company, its business and the terms and conditions of the offering of the Securities, and has conducted and completed its own independent due diligence. Such Investor acknowledges that copies of the SEC Filings are available on the EDGAR system. Based on the information such Investor has deemed appropriate, it has independently made its own analysis and decision to enter into the Transaction Documents. Such Investor is relying exclusively on its own investment analysis and due diligence (including professional advice it deems appropriate) with respect to the execution, delivery and performance of the Transaction Documents, the Securities and the business, condition (financial and otherwise), management, operations, properties and prospects of the Company, including but not limited to all business, legal, regulatory, accounting, credit and tax matters. Neither such inquiries nor any other due diligence investigation conducted by such Investor shall modify, limit or otherwise affect such Investor's right to rely on the Company's representations and warranties contained in this Agreement. Each Investor acknowledges that the Placement Agents have not acted as such Investor's financial advisor or fiduciary and such

Investor is not relying on the Placement Agents for any accounting, legal or tax advice in connection with making an investment decision in the Securities.

5.6 Restricted Securities. Such Investor understands that the Securities are characterized as “restricted securities” under the U.S. federal securities laws inasmuch as they are being acquired from the Company in a transaction not involving a public offering and that under such laws and applicable regulations such securities may be resold without registration under the 1933 Act only in certain limited circumstances.

5.7 Legends. It is understood that, except as provided below, certificates or book-entry positions evidencing the Securities may bear the following or any similar legend:

(a) “These securities represented hereby and the securities issuable upon exercise of these securities have not been registered with the Securities and Exchange Commission or the securities commission of any state but have been or will be issued in reliance upon an exemption from registration under the Securities Act of 1933, as amended, and, accordingly, may not be transferred unless (i) such securities have been registered for resale pursuant to the Securities Act of 1933, as amended, (ii) such securities may be sold pursuant to Rule 144, (iii) the Company has received an opinion of counsel reasonably satisfactory to it that such transfer may lawfully be made without registration under the Securities Act of 1933, as amended, or (iv) the securities are transferred without consideration to an affiliate of such holder or a custodial nominee (which for the avoidance of doubt shall require neither consent nor the delivery of an opinion).”

(b) If required by the authorities of any state in connection with the issuance or sale of the Securities, the legend required by such state authority.

5.8 Accredited Investor. Such Investor is an “accredited investor” within the meaning of Rule 501(a) of the 1933 Act. Such Investor has executed and delivered to the Company a questionnaire in substantially the form attached hereto as **Exhibit D** (the “**Investor Questionnaire**”), which such Investor represents and warrants is true, correct and complete. Such investor is a sophisticated institutional investor with sufficient knowledge and experience in investing in private equity transactions to properly evaluate the risks and merits of its purchase of the Securities. Such Investor has determined based on its own independent review and such professional advice as it deems appropriate that its purchase of the Securities and participation in the transactions contemplated by the Transaction Documents (i) are fully consistent with its financial needs, objectives and condition, (ii) comply and are fully consistent with all investment policies, guidelines and other restrictions applicable to such Investor, (iii) have been duly authorized and approved by all necessary action, (iv) do not and will not violate or constitute a default under such Investor’s charter, bylaws or other constituent document or under any law, rule, regulation, agreement or other obligation by which such Investor is bound and (v) are a fit, proper and suitable investment for such Investor, notwithstanding the substantial risks inherent in investing in or holding the Securities. Furthermore, each such Investor is an “Institutional Account” as defined in FINRA Rule 4512(c).

5.9 No General Solicitation. Such Investor did not learn of the investment in the Securities as a result of any general or public solicitation or general advertising, or publicly disseminated advertisements or sales literature, including (a) any advertisement, article, notice or other communication published in any newspaper, magazine, website, or similar media, or broadcast over television or radio, or (b) any seminar or meeting to which such Investor was invited by any of the foregoing means of communications.

5.10 Brokers and Finders. No Person will have, as a result of the transactions contemplated by the Transaction Documents, any valid right, interest or claim against or upon the Company or an Investor for any commission, fee or other compensation pursuant to any agreement, arrangement or understanding entered into by or on behalf of such Investor.

5.11 Short Sales and Confidentiality Prior to the Date Hereof. Other than consummating the transactions contemplated hereunder, such Investor has not, nor has any Person acting on behalf of or pursuant to any understanding with such Investor, directly or indirectly executed any purchases or sales, including Short Sales, of the securities of the Company during the period commencing as of the time that such Investor was first contacted by the Company or any other Person regarding the transactions contemplated hereby and ending immediately prior to the date hereof. Notwithstanding the foregoing, in the case of an Investor that is a multi-managed investment vehicle whereby separate portfolio managers manage separate portions of such Investor’s assets, the representation set forth above shall only apply with respect to the portion of assets managed by the portfolio manager that made the investment decision to purchase the Securities covered by this Agreement. Other than to other Persons party to this Agreement and other than to such Person’s outside attorney, accountant, auditor or investment advisor only to the extent necessary to permit evaluation of the investment, and the performance of the necessary or required tax, accounting, financial, legal, or administrative tasks and services and other than as may be required by law, such Investor has maintained the confidentiality of all disclosures made to it in connection with this transaction (including

the existence and terms of this transaction). Notwithstanding the foregoing, for avoidance of doubt, nothing contained herein shall constitute a representation or warranty, or preclude any actions, with respect to the identification of the availability of, or securing of, available shares to borrow in order to effect Short Sales or similar transactions in the future.

5.12 No Government Recommendation or Approval. Such Investor understands that no United States federal or state agency, or similar agency of any other country, has reviewed, approved, passed upon, or made any recommendation or endorsement of the Company or the purchase of the Securities.

5.13 No Intent to Effect a Change of Control. Such Investor has no present intent to effect a "change of control" of the Company as such term is understood under the rules promulgated pursuant to Section 13(d) of the 1934 Act.

5.14 Residency. Such Investor's office in which its investment decision with respect to the Securities was made is located at the address immediately below such Investor's name on its signature page hereto.

5.15 No Conflicts. The execution, delivery and performance by such Investor of the Transaction Documents and the consummation by such Investor of the transactions contemplated hereby and thereby will not (i) result in a violation of the organizational documents of such Investor or (ii) conflict with, or constitute a default (or an event which with notice or lapse of time or both would become a default) under, or give to others any rights of termination, amendment, acceleration or cancellation of, any agreement, indenture or instrument to which such Investor is a party, or (iii) result in a violation of any law, rule, regulation, order, judgment or decree (including federal and state securities laws) applicable to such Investor, except in the case of clauses (ii) and (iii) above, for such conflicts, defaults, rights or violations which would not, individually or in the aggregate, reasonably be expected to have a material adverse effect on the ability of such Investor to perform its obligations hereunder.

5.16. Reliance on Representations and Warranties. Each Investor acknowledges and agrees that the Placement Agents are entitled to rely on the accuracy of these representations.

6. Conditions to Closing.

6.1 Conditions to the Investors' Obligations. The obligation of each Investor to purchase Closing Securities at the Closing is subject to the fulfillment to such Investor's satisfaction, on or prior to the Closing Date, of the following conditions, any of which may be waived by such Investor (as to itself only):

(a) The representations and warranties made by the Company in Section 4 hereof, as qualified by the SEC Filings, shall be true and correct in all material respects, except for those representations and warranties qualified by materiality or Material Adverse Effect, which shall be true and correct in all respects, as of the date hereof and as of the Closing Date, as though made on and as of such date, except to the extent any such representation or warranty expressly speaks as of an earlier date, in which case such representation or warranty shall be true and correct in all material respects, except for those representations and warranties qualified by materiality or Material Adverse Effect, which shall be true and correct in all respects, as of such earlier date. The Company shall have performed in all material respects all obligations and covenants herein required to be performed by it on or prior to the Closing Date.

(b) The Company shall have obtained any and all consents, permits, approvals, registrations and waivers necessary for the consummation of the purchase and sale of the Closing Securities and the consummation of the other transactions contemplated by the Transaction Documents, all of which shall be in full force and effect.

(c) The Company shall have executed and delivered the Registration Rights Agreement.

(d) The Company shall have filed with Nasdaq a Notification Form: Listing of Additional Shares for the listing of the Shares and the Warrant Shares, and Nasdaq shall have raised no objection to the consummation of the transactions contemplated by the Transaction Documents.

(e) No judgment, writ, order, injunction, award or decree of or by any court, or judge, justice or magistrate, including any bankruptcy court or judge, or any order of or by any governmental authority, shall have been issued, and no action or proceeding shall have been instituted by any governmental authority, enjoining or preventing the consummation of the transactions contemplated hereby or in the other Transaction Documents.

(f) The Company shall have delivered a Certificate, executed on behalf of the Company by its Chief Executive Officer or its Chief Financial Officer, dated as of the Closing Date, certifying to the fulfillment of the conditions specified in subsections (a), (b), (d), (e), (i), (j) and (k) of this Section 6.1.

(g) The Company shall have delivered a Certificate, executed on behalf of the Company by its Secretary, dated as of the Closing Date, certifying the resolutions adopted by the Board of the Company approving the transactions contemplated by this Agreement, the other Transaction Documents, the issuance of the Securities, certifying the current versions of the Certificate of Incorporation and Bylaws of the Company and certifying as to the signatures and authority of persons signing the Transaction Documents and related documents on behalf of the Company.

(h) The Investors shall have received an opinion from Cooley LLP, the Company's counsel, dated as of the Closing Date, in form and substance reasonably acceptable to the Investors on which opinion the Placement Agents may rely or, if the Placement Agents so request, of which opinion the Placement Agents may be specifically named as addressees.

(i) There shall have been no Material Adverse Effect with respect to the Company since the date hereof.

(j) No stop order or suspension of trading shall have been imposed by Nasdaq, the SEC or any other governmental or regulatory body with respect to public trading in the Common Stock.

(k) The Company shall have delivered lock-up agreements substantially in the form of **Exhibit E** hereto signed by each of the Company's directors and executive officers to the Placement Agents.

6.2 Conditions to Obligations of the Company. The Company's obligation to sell and issue Closing Securities at the Closing to each Investor is subject to the fulfillment to the satisfaction of the Company on or prior to the Closing Date of the following conditions, any of which may be waived by the Company:

(a) The representations and warranties made by such Investor in Section 5 hereof shall be true and correct in all material respects as of the date hereof, and shall be true and correct as of the Closing Date with the same force and effect as if they had been made on and as of such date, except to the extent any such representation or warranty expressly speaks as of an earlier date, in which case such representation or warranty shall be true and correct in all material respects as of such earlier date. Such Investor shall have performed in all material respects all obligations and covenants herein required to be performed by them on or prior to the Closing Date.

(b) Such Investor shall have executed and delivered the Registration Rights Agreement and an Investor Questionnaire.

(c) Such Investor purchasing Closing Securities at the Closing shall have paid in full its purchase price to the Company.

6.3 Termination of Obligations to Effect Closing; Effects.

(a) The obligations of the Company, on the one hand, and the Investors, on the other hand, to effect the Closing shall terminate as follows:

(i) Upon the mutual written consent of the Company and Investors that agreed to purchase a majority of the Securities to be issued and sold pursuant to this Agreement; or

(ii) By either the Company or any Investor (with respect to itself only) if the Closing has not occurred on or prior to May 22, 2023; provided, however, that, except in the case of clause (i) above, the party seeking to terminate its obligation to effect the Closing shall not then be in breach of any of its representations, warranties, covenants or agreements contained in this Agreement or the other Transaction Documents if such breach has resulted in the circumstances giving rise to such party's seeking to terminate its obligation to effect the Closing.

(b) In the event of termination by the Company or any Investor of its obligations to effect the Closing pursuant to Section 6.3(a)(ii), written notice thereof shall be given to the other Investors by the Company and the other Investors shall have the right to terminate their obligations to effect the Closing upon written notice to the Company and the other Investors. Nothing in this Section 6.3 shall be deemed to release any party from any liability for any breach by such party of the terms and provisions of this Agreement or the other Transaction Documents or to impair the right of any party to compel specific performance by any other party of its obligations under this Agreement or the other Transaction Documents.

7. Covenants and Agreements of the Parties

7.1 Nasdaq Listing. The Company will use commercially reasonable efforts to continue the listing and trading of its Common Stock on Nasdaq and, in accordance therewith, will use commercially reasonable efforts to comply in all

material respects with the Company's reporting, filing and other obligations under the bylaws or rules of such market or exchange, as applicable.

7.2 Removal of Legends. Subject to receipt from the Investor by the Company and the transfer agent for the Common Stock (the "**Transfer Agent**") of customary representations and other documentation reasonably acceptable to the Company and the Transfer Agent in connection therewith, upon the earliest of such time as the Shares or the Warrant Shares (i) have been registered under the 1933 Act pursuant to an effective registration statement, (ii) have been sold pursuant to Rule 144 or any other exemption under the 1933 Act, or (iii) are eligible for resale under Rule 144(b)(1) or any successor provision, the Company shall, in accordance with the provisions of this Section 7.2(b) and within two (2) Trading Days of any request therefor from an Investor accompanied by such customary and reasonably acceptable documentation referred to above, (A) deliver to the Transfer Agent irrevocable instructions that the Transfer Agent shall make a new, unlegended entry for such book entry shares, and (B) cause its counsel to deliver to the Transfer Agent one or more opinions to the effect that the removal of such legends in such circumstances may be effected under the 1933 Act if required by the Transfer Agent to effect the removal of the legend in accordance with the provisions of this Agreement. Any shares subject to legend removal under this Section 7.2 may be transmitted by the Transfer Agent to the Investor by crediting the account of the Investor's prime broker with the DTC System as directed by such Investor. The Company shall be responsible for the fees of its Transfer Agent and all DTC fees associated with such issuance.

7.3 Transfer Restrictions. Each Investor agrees that it will sell, transfer or otherwise dispose of the Securities only in compliance with all applicable state and federal securities laws and that any Securities sold by such Investor pursuant to an effective registration statement will be sold in compliance with the plan of distribution set forth therein.

7.4 Subsequent Equity Sales by the Company. The Company shall not, and shall use its commercially reasonable efforts to ensure that no Affiliate of the Company shall, sell, offer for sale or solicit offers to buy or otherwise negotiate in respect of any security (as defined in Section 2 of the 1933 Act) that will be integrated with the offer or sale of the Securities in a manner that would require the registration under the 1933 Act of the sale of the Securities to the Investors, or that will be integrated with the offer or sale of the Securities for purposes of the rules and regulations of any trading market such that it would require stockholder approval prior to the closing of such other transaction unless stockholder approval is obtained before the closing of such subsequent transaction. The Company shall not take any action or steps that would adversely affect reliance by the Company on Section 4(a)(2) for the exemption from registration for the transactions contemplated hereby or require registration of the Securities under the 1933 Act.

7.5 Fees. The Company shall be responsible for the payment of any placement agent's fees, financial advisory fees, or broker's commissions (other than for Persons engaged by any Investor) relating to or arising out of the transactions contemplated hereby.

7.6 Reservation of Common Stock. As of the date hereof, the Company has reserved and the Company shall continue to reserve and keep available at all times, free of preemptive rights, a sufficient number of shares of Common Stock for the purpose of enabling the Company to issue all of the Warrant Shares upon conversion of any Pre-Funded Warrant.

7.7 Short Sales and Confidentiality After the Date Hereof. Each Investor covenants that it will not, nor will it cause any Affiliates acting on its behalf or pursuant to any understanding with it to, execute any Short Sales during the period from the date hereof until the earlier of such time as (i) the transactions contemplated by this Agreement are first publicly announced or (ii) this Agreement is terminated in full. Notwithstanding the foregoing, in the case of an Investor that is a multi-managed investment vehicle whereby separate portfolio managers manage separate portions of such Investor's assets, the covenant set forth above shall only apply with respect to the portion of assets managed by the portfolio manager that made the investment decision to purchase the Securities covered by this Agreement. Each Investor covenants that until such time as the transactions contemplated by this Agreement are publicly disclosed by the Company, such Investor will maintain the confidentiality of all disclosures made to it in connection with this transaction (including the existence and terms of this transaction), other than to such Person's outside attorney, accountant, auditor or investment advisor only to the extent necessary to permit evaluation of the investment, and the performance of the necessary or required tax, accounting, financial, legal, or administrative tasks and services and other than as may be required by law. Each Investor understands and acknowledges that the SEC currently takes the position that coverage of Short Sales of shares of the Common Stock "against the box" prior to effectiveness of a resale registration statement with securities included in such registration statement would be a violation of Section 5 of the 1933 Act, as set forth in Item 239.10 of the Securities Act Rules Compliance and Disclosure Interpretations compiled by the Office of Chief Counsel, Division of Corporation Finance.

7.8 Tax Matters. The parties agree that the Pre-Funded Warrants are intended to and shall be treated as stock in the Company for U.S. federal, state and local income tax purposes, and the parties shall file their tax returns and otherwise act consistently with such treatment except as otherwise required by a final determination within the meaning of Section 1313 of the Internal Revenue Code of 1986, as amended.

7.9 Filings. The Company shall make all filings with the SEC and its Trading Market as required by the transactions contemplated hereby. With respect to any exercise of a Pre-Funded Warrant into Common Stock, the Company and each Investor (i) shall use their respective commercially reasonable efforts to promptly file or cause to be filed, (x) within 10 Business Days from the date that either the Company or any Investor provides any notice of exercise (for which within five Business Days the Investor determines that a filing under the Hart Scott-Rodino Antitrust Improvements Act of 1976, as amended (the "**HSR Act**"), is required, and so notifies the Company), all required filings under the HSR Act and, (y) as promptly as reasonably practicable, all required filings under other applicable antitrust laws that the Company or any Investor reasonably determines in good faith to be necessary or appropriate to effect the transactions contemplated by this Agreement including but not limited to, the exercise of any Pre-Funded Warrant into Common Stock, (ii) shall consult and cooperate with each other in the preparation of such filings, and (iii) shall promptly inform the other parties of any material communication received by such party from any Governmental Entity regarding the transactions contemplated by this Agreement and shall enable the other party to participate in any communications and meetings with any Governmental Entity regarding the transactions contemplated by this Agreement unless prohibited by the Governmental Entity. Each of the Company and any Investor that files such notice pursuant to the HSR Act or any other applicable antitrust law in accordance with the preceding sentence acknowledges that no exercise of any Pre-Funded Warrant into Common Stock will be consummated until any waiting period prescribed under the HSR Act or any other applicable antitrust law has elapsed.

7.10 Clear Market. Prior to 60 days after the Closing Date, the Company will not, and will not publicly disclose an intention to, (i) offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase, hedge, lend, or otherwise transfer or dispose of, directly or indirectly, any shares of Common Stock or submit to, or file with, the SEC a registration statement under the Securities Act, or (ii) enter into any swap, hedging or other agreement that transfers, in whole or in part, any of the economic consequences of ownership of the Common Stock or any such other securities, whether any such transaction described in clause (i) or (ii) above is to be settled by delivery of Common Stock or such other securities, in cash or otherwise, other than (A) any shares of Common Stock and options to purchase Common Stock, shares of Common Stock underlying options granted and other securities, each pursuant to any director or employee stock incentive plan, stock ownership plan or dividend reinvestment plan of the Company in effect on the date hereof; (B) any purchases or sales made pursuant to new, existing or amendments to trading plans established in compliance with Rule 10b5-1 of the 1934 Act; (C) any shares of Common Stock of the Company issued upon the exercise of convertible securities of the Company outstanding on the date hereof, including, for the avoidance of doubt, the pre-funded warrants, Class A Warrants and Class C Warrants of the Company outstanding on the date hereof; (D) the filing of a registration statement by the Company, pursuant to the Registration Rights Agreement; and (E) the filing of a registration statement by the Company for the exercise of the outstanding Class A Warrants and Class C Warrants.

8. Survival and Indemnification.

8.1 Survival. The representations, warranties, covenants and agreements contained in this Agreement shall survive the Closing of the transactions contemplated by this Agreement for the applicable statute of limitations.

8.2 Indemnification. The Company agrees to indemnify and hold harmless each Investor and its Affiliates, and their respective directors, officers, trustees, members, managers, employees, investment advisers and agents, from and against any and all losses, claims, damages, liabilities and expenses (including without limitation reasonable and documented attorney fees and disbursements and other documented out-of-pocket expenses reasonably incurred in connection with investigating, preparing or defending any action, claim or proceeding, pending or threatened and the costs of enforcement thereof) to which such Person may become subject as a result of any breach of representation, warranty, covenant or agreement made by or to be performed on the part of the Company under the Transaction Documents, and will reimburse any such Person for all such amounts as they are incurred by such Person solely to the extent such amounts have been finally judicially determined not to have resulted from such Person's fraud or willful misconduct.

8.3 Conduct of Indemnification Proceedings. Any person entitled to indemnification hereunder shall (i) give prompt written notice to the indemnifying party of any claim with respect to which it seeks indemnification and (ii) permit such indemnifying party to assume the defense of such claim with counsel reasonably satisfactory to the indemnified party; *provided* that any person entitled to indemnification hereunder shall have the right to employ separate counsel and to participate in the defense of such claim, but the fees and expenses of such counsel shall be at

the expense of such person unless (a) the indemnifying party has agreed in writing to pay such fees or expenses, (b) the indemnifying party shall have failed to assume the defense of such claim and employ counsel reasonably satisfactory to such person or (c) in the reasonable judgment of any such person, based upon written advice of its counsel, a conflict of interest exists between such person and the indemnifying party with respect to such claims (in which case, if the person notifies the indemnifying party in writing that such person elects to employ separate counsel at the expense of the indemnifying party, the indemnifying party shall not have the right to assume the defense of such claim on behalf of such person); and *provided, further*, that the failure of any indemnified party to give written notice as provided herein shall not relieve the indemnifying party of its obligations hereunder, except to the extent that such failure to give notice shall materially adversely affect the indemnifying party in the defense of any such claim or litigation. It is understood that the indemnifying party shall not, in connection with any proceeding in the same jurisdiction, be liable for fees or expenses of more than one separate firm of attorneys at any time for all such indemnified parties. No indemnifying party will, except with the consent of the indemnified party, which consent shall not be unreasonably withheld, conditioned or delayed, consent to entry of any judgment or enter into any settlement that does not include as an unconditional term thereof the giving by the claimant or plaintiff to such indemnified party of a release from all liability in respect of such claim or litigation. No indemnified party will, except with the consent of the indemnifying party, which consent shall not be unreasonably withheld, conditioned or delayed, consent to entry of any judgment or enter into any settlement.

9. Miscellaneous.

9.1 Successors and Assigns. This Agreement may not be assigned by a party hereto without the prior written consent of the Company or each of the Investors, as applicable, provided, however, that an Investor may assign its rights and delegate its duties hereunder in whole or in part to an Affiliate or to a third party acquiring some or all of its Securities in a transaction complying with applicable securities laws without the prior written consent of the Company or the other Investors, provided such assignee agrees in writing to be bound by the provisions hereof that apply to Investors. The provisions of this Agreement shall inure to the benefit of and be binding upon the respective permitted successors and assigns of the parties. Without limiting the generality of the foregoing, in the event that the Company is a party to a merger, consolidation, share exchange or similar business combination transaction in which the Common Stock is converted into the equity securities of another Person, from and after the effective time of such transaction, such Person shall, by virtue of such transaction, be deemed to have assumed the obligations of the Company hereunder, the term "Company" shall be deemed to refer to such Person and the term "Securities" shall be deemed to refer to the securities received by the Investors in connection with such transaction. Nothing in this Agreement, express or implied, is intended to confer upon any party other than the parties hereto or their respective permitted successors and assigns any rights, remedies, obligations, or liabilities under or by reason of this Agreement, except as expressly provided in this Agreement.

9.2 Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. Counterparts may be delivered via facsimile, electronic mail (including pdf or any electronic signatures complying with the U.S. federal E-SIGN Act of 2000, e.g., www.docusign.com) or other transmission method and any counterpart so delivered shall be deemed to have been duly and validly delivered and be valid and effective for all purposes.

9.3 Titles and Subtitles. The titles and subtitles used in this Agreement are used for convenience only and are not to be considered in construing or interpreting this Agreement.

9.4 Notices. Unless otherwise provided, any notice required or permitted under this Agreement shall be given in writing and shall be deemed effectively given as hereinafter described (i) if given by personal delivery, then such notice shall be deemed given upon such delivery, (ii) if given by e-mail, then such notice shall be deemed given on the date of transmission (provided that notice shall not be considered given or effective if the sender receives an automatic system-generated response that such e-mail was undeliverable), (iii) if given by mail, then such notice shall be deemed given upon the earlier of (A) receipt of such notice by the recipient or (B) three days after such notice is deposited in first class mail, postage prepaid, and (iv) if given by an internationally recognized overnight air courier, then such notice shall be deemed given one Business Day after delivery to such carrier. All notices shall be addressed to the party to be notified at the address as follows, or at such other address as such party may designate by ten days' advance written notice to the other party:

If to the Company:

X4 Pharmaceuticals, Inc.
61 North Beacon Street, 4th Floor
Boston, MA 02134
Telephone: 857-529-8300
Attention: Adam Mostafa

Email: adam.mostafa@x4pharma.com

With a copy (which shall not constitute notice) to:

Cooley LLP
55 Hudson Yards
New York, NY 10001
Telephone: (212) 479-5000
Facsimile: (212) 479-6275
Attention: Daniel I. Goldberg
Email: dgoldberg@cooley.com

If to the Investors:

Only to the addresses set forth on the signature pages hereto.

9.5 Expenses. The parties hereto shall pay their own costs and expenses in connection herewith regardless of whether the transactions contemplated hereby are consummated; it being understood that each of the Company and each Investor has relied on the advice of its own respective counsel.

9.6 Amendments and Waivers. Prior to Closing, no amendment or waiver of any provision of this Agreement will be effective with respect to any party unless made in writing and signed by a duly authorized representative of such party. Following the Closing, any term of this Agreement may be amended and the observance of any term of this Agreement may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of the Company and the Required Investors. Notwithstanding the foregoing, this Agreement may not be amended and the observance of any term of this Agreement may not be waived with respect to any Investor without the written consent of such Investor unless such amendment or waiver applies to all Investors in the same fashion. Any amendment or waiver effected in accordance with this paragraph shall be binding upon (i) prior to Closing, each Investor that signed such amendment or waiver and (ii) following the Closing, each holder of any Securities purchased under this Agreement at the time outstanding, and in each case, each future holder of all such Securities and the Company.

9.7 Publicity. Except as set forth below, no public release or announcement concerning the transactions contemplated hereby shall be issued by the Investors without the prior consent of the Company, except as such release or announcement may be required by law or the applicable rules or regulations of any securities exchange or securities market, in which case the Investors shall allow the Company reasonable time to comment on such release or announcement in advance of such issuance. Notwithstanding the foregoing, each Investor may identify the Company and the value of such Investor's security holdings in the Company in accordance with applicable investment reporting and disclosure regulations or internal policies without prior notice to or consent from the Company (including, for the avoidance of doubt, filings pursuant to Sections 13 and 16 of the 1934 Act). The Company shall not include the name of any Investor or any Affiliate or investment adviser of such Investor in any press release or public announcement (which, for the avoidance of doubt, shall not include any SEC Filing to the extent such disclosure is required by SEC rules and regulations) without the prior written consent of such Investor. No later than the close of market of the Business Day immediately following the date this Agreement is executed, the Company shall issue a press release or file a Form 8-K with the SEC disclosing all material terms of the transactions contemplated by this Agreement and the other Transaction Documents and any material non-public information that the Company may have provided any Investor in connection with the transactions contemplated by this Agreement at any time prior to the issuance of such press release or Form 8-K (the "**Public Disclosure**"). In addition, the Company will make such other filings and notices in the manner and time required by the SEC or Nasdaq. From and after the issuance of the Public Disclosure, no Investor shall be in possession of any material non-public information received from the Company, its subsidiaries or any of their respective officers, directors, employees or agents in connection with the transactions contemplated by this Agreement and each Investor shall no longer be subject to any confidentiality or similar obligations with respect to transactions contemplated by the Transaction Documents.

9.8 Severability. Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof but shall be interpreted as if it were written so as to be enforceable to the maximum extent permitted by applicable law, and any such prohibition or unenforceability in any jurisdiction shall not invalidate or render unenforceable such provision in any other jurisdiction. To the extent permitted by applicable law, the parties hereby waive any provision of law which renders any provision hereof prohibited or unenforceable in any respect.

9.9 Entire Agreement. This Agreement, including the signature pages, Exhibits, the other Transaction Documents and any confidentiality agreement between the Company and each Investor constitute the entire agreement among the parties hereof with respect to the subject matter hereof and thereof and supersede all prior agreements and understandings, both oral and written, between the parties with respect to the subject matter hereof and thereof; provided, however, that with respect to any conflict between this Agreement and the Registration Rights Agreement, the Registration Rights Agreement shall govern as it relates to the registration of the resale of the Shares.

9.10 Further Assurances. The parties shall execute and deliver all such further instruments and documents and take all such other actions as may reasonably be required to carry out the transactions contemplated hereby and to evidence the fulfillment of the agreements herein contained.

9.11 Governing Law. This Agreement shall be governed by, and construed in accordance with, the laws of the State of Delaware. Service of process in connection with any such suit, action or proceeding may be served on each party hereto anywhere in the world by the same methods as are specified for the giving of notices under this Agreement.

9.12 Independent Nature of Investors' Obligations and Rights. The obligations of each Investor under any Transaction Document are several and not joint with the obligations of any other Investor, and no Investor shall be responsible in any way for the performance of the obligations of any other Investor under any Transaction Document. The decision of each Investor to purchase Closing Securities pursuant to the Transaction Documents has been made by such Investor independently of any other Investor. Nothing contained herein or in any Transaction Document, and no action taken by any Investor pursuant thereto, shall be deemed to constitute the Investors as a partnership, an association, a joint venture or any other kind of entity, or create a presumption that the Investors are in any way acting in concert or as a group with respect to such obligations or the transactions contemplated by the Transaction Documents. Each Investor acknowledges that no other Investor has acted as agent for such Investor in connection with making its investment hereunder and that no Investor will be acting as agent of such Investor in connection with monitoring its investment in the Securities or enforcing its rights under the Transaction Documents. Each Investor shall be entitled to independently protect and enforce its rights, including, without limitation, the rights arising out of this Agreement or out of the other Transaction Documents, and it shall not be necessary for any other Investor to be joined as an additional party in any proceeding for such purpose. The Company acknowledges that each of the Investors has been provided with the same Transaction Documents for the purpose of closing a transaction with multiple Investors and not because it was required or requested to do so by any Investor. It is expressly understood and agreed that each provision contained in this Agreement is between the Company and an Investor, solely, and not between the Company and the Investors collectively and not between and among the Investors.

[remainder of page intentionally left blank]

IN WITNESS WHEREOF, the parties have executed this Agreement or caused their duly authorized officers to execute this Agreement as of the date first above written.

COMPANY:

X4 PHARMACEUTICALS, INC.

By: /s/ Adam Mostafa
Name: Adam S. Mostafa
Title: Chief Financial Officer

[Signature Page to Securities Purchase Agreement]

INVESTOR:
405 MSTV I LP

By: Tri Locum Partners LP as sub-advisor to 405 MSTV I LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

[Signature Page to Securities Purchase Agreement]

INVESTOR:

New Holland Tactical Alpha Fund LP

By: Tri Locum Partners LP as sub-advisor to New Holland
Tactical Alpha Fund LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

[Signature Page to Securities Purchase Agreement]

INVESTOR:

Tri Locum Healthcare Master Fund LP

By: Tri Locum Partners LP as Investment
Advisor to Tri Locum Healthcare Master
Fund LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

[Signature Page to Securities Purchase Agreement]

INVESTOR:

Stonepine Capital, LP

By: /s/ Timothy P. Lynch
Name: Timothy P. Lynch
Title: Managing Member of the GP

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INVESTOR:

**ORBIMED PRIVATE INVESTMENTS
IV, LP**

By: OrbiMed Capital GP IV LLC,
its General Partner

By: OrbiMed Advisors LLC,
its Managing Member

By: /s/ Carl Gordon
Name: Carl Gordon
Title: Member

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**CVI Investments, Inc., By: Heights Capital Management, Inc.,
its authorized agent**

By: /s/ Martin Kobinger
Name: Martin Kobinger
Title: President

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INVESTOR:

Adage Capital Partners LP

By: /s/ Dan Lehan

Name: Dan Lehan

Title: COO

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**INTEGRATED CORE STRATEGIES
(US) LLC**

By: Integrated Holding Group LP, its
Managing Member

By: Millennium Management LLC, its
General Partner

By: /s/ Mark Meskin
Name: Mark Meskin
Title: Chief Trading Officer

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INVESTOR:

Growth Equity Opportunities 18 VGE, LLC

By: NEA 18 VENTURE GROWTH EQUITY, L.P., its sole member

By: NEA PARTNERS VG 18, L.P., its general partner

By: NEA VG 18 GP, LLC, its general partner

By: /s/ Louis C. Citron
Name: Louis C. Citron
Title: Chief Legal Officer

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INVESTOR:

Lytton-Kambara Foundation

By: /s/ Laurence Lytton
Name: Laurence Lytton
Title: President

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INVESTOR:

**KINGDON HEALTHCARE MASTER
FUND, LP**

By: Kingdon Capital Management, LLC, as agent and investment
adviser

By: /s/ William Walsh
Name: William Walsh
Title: Chief Financial Officer

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**M. KINGDON OFFSHORE MASTER
FUND, LP**

By: Kingdon Capital Management, LLC,
as agent and investment adviser

By: /s/ William Walsh
Name: William Walsh
Title: Chief Financial Officer

[Signature Page to Securities Purchase Agreement]

INVESTOR:

BCLS I Investco, LP

By: BCLS I Investco GP, LLC, its general partner

By: Bain Capital Life Sciences Fund, L.P., its manager

By: Bain Capital Life Sciences Partners, L.P., its general partner

By: Bain Capital Life Sciences Investors, LLC, its general partner

By: /s/ Andrew Hack

Name: Andrew Hack

Title: Partner

[Signature Page to Securities Purchase Agreement]

INVESTOR:

BCLS II Investco, LP

By: BCLS II Investco (GP), LLC, its general partner

By: Bain Capital Life Sciences Fund II, L.P., its manager

By: Bain Capital Life Sciences Investors II, LLC, its general partner

By: Bain Capital Life Sciences Investors, LLC, its manager

By: /s/ Andrew Hack
Name: Andrew Hack
Title: Partner

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Asset Master, LTD**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Tax Efficient, LP**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Securities Purchase Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Tax Efficient III, LP**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Securities Purchase Agreement]

INVESTOR:

ACORN BIOVENTURES, L.P.

By: ACORN CAPITAL ADVISORS GP, LLC
Its: General Partner

By: /s/ Isaac Manke
Name: Isaac Manke
Title: Member

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INVESTOR:

ACORN BIOVENTURES 2, L.P.

By: ACORN CAPITAL ADVISORS 2 GP, LLC
Its: General Partner

By: /s/ Isaac Manke
Name: Isaac Manke
Title: Member

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INVESTOR:

CITADEL CEMF INVESTMENTS LTD.

By: Citadel Advisors LLC, its portfolio manager

By: /s/ Christopher L. Ramsay
Name: Christopher L. Ramsay
Title: Authorized Signatory

[Signature Page to Securities Purchase Agreement]

INVESTOR:

Parkman HP Master Fund LP

By: /s/ Gregory Martinez
Name: Gregory Martinez
Title: Managing Member, GP

[Signature Page to Securities Purchase Agreement]

INVESTOR:

Schonfeld EXT Master Fund LP

By: /s/ Trina Geatz
Name: Trina Geatz
Title: Deputy Chief Operating Officer

[Signature Page to Securities Purchase Agreement]

EXHIBIT A
Schedule of Investors

Investor Name	Number of Shares	Number of Warrant Shares Underlying Pre-Funded Warrant	Aggregate Purchase Price of Securities
TOTAL			

EXHIBIT B
Form of Pre-Funded Warrant

EXHIBIT C
Form of Registration Rights Agreement

EXHIBIT D
Investor Questionnaire

EXHIBIT E
Form of Lock-up Agreement

REGISTRATION RIGHTS AGREEMENT

This REGISTRATION RIGHTS AGREEMENT (this “Agreement”) is made and entered into as of May 15, 2023, by and among X4 Pharmaceuticals, Inc., a Delaware corporation (the “Company”), and the “Investors” named in that certain Securities Purchase Agreement by and among the Company and the Investors, dated as of May 15 2023 (the “Purchase Agreement”). Capitalized terms used herein have the respective meanings ascribed thereto in the Purchase Agreement unless otherwise defined herein.

The parties hereby agree as follows:

1. Definitions.

As used in this Agreement, the following terms shall have the following meanings:

“Agreement” has the meaning set forth in the first paragraph.

“Allowed Delay” has the meaning set forth in Section 2(c)(ii).

“Company” has the meaning set forth in the first paragraph.

“Constructive Primary Offering” has the meaning set forth in Section 2(e).

“Cut Back Shares” has the meaning set forth in Section 2(e).

“Effectiveness Deadline” means, with respect to the Registration Statement, the forty-fifth calendar day following the Filing Deadline (or, in the event the SEC reviews and has written comments to the Registration Statement, the one hundredth calendar day following the Filing Deadline); provided, however, that if the Effectiveness Deadline falls on a Saturday, Sunday or other day that the Commission is closed for business, the Effectiveness Deadline shall be extended to the next Business Day on which the Commission is open for business.

“Effectiveness Period” has the meaning set forth in Section 3(a).

“Filing Deadline” has the meaning set forth in Section 2(a)(i).

“Inspectors” has the meaning set forth in Section 3(k).

“Investors” means the Investors identified in the Purchase Agreement and any Affiliate or permitted transferee of any Investor who is a subsequent holder of Registrable Securities.

“Investor Information” has the meaning set forth in Section 5(b).

“Liquidated Damages” has the meaning set forth in Section 2(d)(ii).

“Losses” has the meaning set forth in Section 5(a).

“Maintenance Failure” has the meaning set forth in Section 2(d)(ii).

“Maintenance Liquidated Damages” has the meaning set forth in Section 2(d)(ii).

“Prospectus” means (i) the prospectus included in any Registration Statement, as amended or supplemented by any prospectus supplement, with respect to the terms of the offering of any portion of the Registrable Securities covered by such Registration Statement and by all other amendments and supplements to the prospectus, including post-effective amendments and all material incorporated by reference in such prospectus, and (ii) any “free writing prospectus” as defined in Rule 405 under the 1933 Act.

“Purchase Agreement” has the meaning set forth in the first paragraph.

“Qualification Date” has the meaning set forth in Section 2(a)(ii).

“Qualification Deadline” has the meaning set forth in Section 2(a)(ii).

“Questionnaire” has the meaning set forth in Section 4(a).

“Records” has the meaning set forth in Section 3(k).

“Register” “registered” and “registration” refer to a registration made by preparing and filing a Registration Statement or similar document in compliance with the 1933 Act, and the declaration or ordering of effectiveness of such Registration Statement or document.

“Registrable Securities” means (i) the Shares, (ii) the Warrant Shares and (iii) any other securities issued or issuable with respect to or in exchange for Shares or Warrant Shares, whether by merger, charter amendment or otherwise; provided, that a security shall cease to be a Registrable Security upon (A) sale pursuant to a Registration Statement or Rule 144 under the 1933 Act, or (B) such security becoming eligible for sale without restriction by the Investor holding such security pursuant to Rule 144, including without any manner of sale or volume limitations, and without the requirement to be in compliance with Rule 144(c)(1) (or any successor thereto) promulgated under the 1933 Act.

“Registration Liquidated Damages” has the meaning set forth in Section 2(d)(i).

“Registration Statement” means any registration statement of the Company under the 1933 Act that covers the resale of any of the Registrable Securities pursuant to the provisions of this Agreement, amendments and supplements to such Registration Statement, including post-effective amendments, all exhibits and all material incorporated by reference in such Registration Statement.

“Required Investors” means the Investors holding at least 75% of the Registrable Securities purchased under the Purchase Agreement.

“Restriction Termination Date” has the meaning set forth in Section 2(e).

“SEC” means the U.S. Securities and Exchange Commission.

“SEC Restrictions” has the meaning set forth in Section 2(e).

“Shelf Registration Statement” has the meaning set forth in Section 2(a)(ii).

2. Registration.

(a) Registration Statements.

(i) Promptly following the Closing Date, but in no event later than thirty (30) days from the date of this Agreement (the “Filing Deadline”), the Company shall prepare and file with the SEC one Registration Statement covering the resale of all of the Registrable Securities. Subject to any SEC comments, such Registration Statement shall include the plan of distribution attached hereto as Exhibit A; provided, however, that no Investor shall be named as an “underwriter” in such Registration Statement without the Investor’s prior written consent. Such Registration Statement also shall cover, to the extent allowable under the 1933 Act and the rules promulgated thereunder (including Rule 416), such indeterminate number of additional shares of Common Stock resulting from stock splits, stock dividends or similar transactions with respect to the Registrable Securities. Such Registration Statement shall not include any shares of Common Stock or other securities for the account of any other holder without the prior written consent of the Required Investors. Such Registration Statement (and each amendment or supplement thereto, and each request for acceleration of effectiveness thereof) shall be provided in accordance with Section 3(c) to the Investors prior to its filing or other submission.

(ii) The Registration Statement referred to in Section 2(a)(i) shall be on Form S-3. In the event that Form S-3 is not available for the registration of the resale of Registrable Securities hereunder, the Company shall (i) register the resale of the Registrable Securities on such other form as is available to the Company and (ii) so long as Registrable Securities remain outstanding, promptly following the date (the “Qualification Date”) upon which the Company becomes eligible to use a registration statement on Form S-3 to register the Registrable Securities for resale, but in no event more than thirty (30) days after the Qualification Date (the “Qualification Deadline”), file a registration statement on Form S-3 covering the Registrable Securities (or a post-effective amendment on Form S-3 to a registration statement on Form S-1) (a “Shelf Registration Statement”) and use commercially reasonable efforts to cause such Shelf Registration Statement to be declared effective as promptly as practicable thereafter; provided that

the Company shall maintain the effectiveness of the Registration Statement then in effect until such time as a Shelf Registration Statement covering the Registrable Securities has been declared effective by the SEC.

(b) Expenses. The Company will pay all expenses associated with each Registration Statement, including filing and printing fees, the Company's counsel and accounting fees and expenses, costs associated with clearing the Registrable Securities for sale under applicable state securities laws and listing fees, but excluding discounts, commissions, fees of underwriters, selling brokers, dealer managers or similar securities industry professionals with respect to the Registrable Securities being sold.

(c) Effectiveness.

(i) The Company shall use commercially reasonable efforts to have each Registration Statement declared effective as soon as practicable after such Registration Statement has been filed with the SEC, but no later than the Effectiveness Deadline. By 5:30 p.m. (Eastern time) on the second Business Day following the date on which the Registration Statement is declared effective by the SEC, the Company shall file with the SEC, in accordance with Rule 424 under the 1933 Act, the final prospectus to be used in connection with sales pursuant to such Registration Statement. The Company shall notify the Investors by e-mail as promptly as practicable, and in any event within twenty-four (24) hours, after any Registration Statement is declared effective and shall simultaneously provide the Investors with copies of any related Prospectus to be used in connection with the sale or other disposition of the securities covered thereby.

(ii) For not more than thirty (30) consecutive days or for a total of not more than sixty days in any twelve (12) month period, the Company may suspend the use of any Prospectus included in any Registration Statement contemplated by this Section 2 in the event that the Company determines in good faith that such suspension is necessary to (A) delay the disclosure of material nonpublic information concerning the Company, the disclosure of which at the time is not, in the good faith opinion of the Company, in the best interests of the Company or (B) amend or supplement the affected Registration Statement or the related Prospectus so that such Registration Statement or Prospectus shall not include an untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein, in the case of the Prospectus in light of the circumstances under which they were made, not misleading (an "Allowed Delay"); provided, that the Company shall promptly (a) notify each Investor in writing of the commencement of an Allowed Delay, but shall not (without the prior written consent of an Investor) disclose to such Investor any material nonpublic information giving rise to an Allowed Delay, (b) advise the Investors in writing to cease all sales under such Registration Statement until the end of the Allowed Delay and (c) use commercially reasonable efforts to terminate an Allowed Delay as promptly as practicable.

(d) Effect of Failure to File and Obtain and Maintain Effectiveness of Registration Statement.

(i) If a Registration Statement covering the Registrable Securities is not filed with the SEC on or prior to the Filing Deadline, the Company will make pro rata payments to each Investor then holding Registrable Securities, as liquidated damages and not as a penalty (the "Registration Liquidated Damages"), in an amount equal to one percent (1.0%) of the aggregate amount invested by such Investor for the initial day of failure to file such Registration Statement by the Filing Deadline and for each 30-day period (or pro rata portion thereof with respect to a final period, if any) thereafter during which no such Registration Statement is filed with respect to the Registrable Securities. Such payments shall be made to each Investor then holding Registrable Securities in cash no later than ten (10) Business Days after the date of the initial failure to file such Registration Statement by the Filing Deadline and the end of each subsequent 30-day period (or portion thereof with respect to a final period, if any) thereafter until such Registration Statement is filed with respect to the Registrable Securities. Interest shall accrue at the rate of one percent (1.0%) per month on any such liquidated damages payments that shall not be paid by the applicable payment date until such amount is paid in full.

(ii) If (A) a Registration Statement covering the Registrable Securities is not declared effective by the SEC (x) prior to the earlier of five (5) Business Days after the SEC informs the Company that no review of such Registration Statement will be made or that the SEC has no further comments on such Registration Statement or (y) the Effectiveness Deadline or (B) after a Registration Statement has been declared effective by the SEC, sales cannot be made pursuant to such Registration Statement for any reason (including, without limitation, by reason of a stop order or the Company's failure to update such Registration Statement), but excluding any Allowed Delay or the inability of any Investor to sell the Registrable Securities covered thereby due to market conditions (each of (A) and (B), a "Maintenance Failure"), then the Company will make pro rata payments to each Investor then holding Registrable Securities, as liquidated damages and not as a penalty (the "Maintenance Liquidated Damages") and together with the Registration Liquidated Damages, the "Liquidated Damages"), in an amount equal to one percent (1.0%) of the aggregate amount invested by such Investor for the Registrable Securities then held by such Investor for the initial day of a Maintenance Failure and for each 30-day period (or pro rata portion thereof with respect to a final period, if any) thereafter until the Maintenance Failure is cured. The Maintenance Liquidated Damages shall be paid monthly.

within ten (10) Business Days of the date of such Maintenance Failure and the end of each subsequent 30-day period (or portion thereof with respect to a final period, if any) thereafter until the Maintenance Failure is cured. Such payments shall be made to each Investor then holding Registrable Securities in cash. Interest shall accrue at the rate of one percent (1%) per month on any such liquidated damages payments that shall not be paid by the applicable payment date until such amount is paid in full.

(iii) The parties agree that (1) notwithstanding anything to the contrary herein or in the Purchase Agreement, no Liquidated Damages shall be payable with respect to any period after the expiration of the Effectiveness Period (as defined below) (it being understood that this sentence shall not relieve the Company of any Liquidated Damages accruing prior to the expiration of the Effectiveness Period), and in no event shall the aggregate amount of Liquidated Damages payable to an Investor exceed, in the aggregate, six percent (6.0%) of the aggregate purchase price paid by such Investor pursuant to the Purchase Agreement and (2) except with respect to (A) the initial day of failure to file a Registration Statement by the Filing Deadline and (B) the initial day of any Maintenance Failure, in no event shall the Company be liable in any thirty (30) day period for Liquidated Damages under this Agreement in excess of one percent (1.0%) of the aggregate purchase price paid by the Investors pursuant to the Purchase Agreement.

(iv) Notwithstanding the foregoing, the Company and the Investors agree that the Company will not be liable for any liquidated damages under this Section 2(d) with respect to any Registrable Securities prior to their issuance. The Liquidated Damages described in this Section 2(d) shall constitute the Investors' exclusive monetary remedy for any failure to meet the Filing Deadline and for any Maintenance Failure, but shall not affect the right of the Investors to injunctive relief.

(e) Rule 415: Cutback. If at any time the SEC takes the position that the offering of some or all of the Registrable Securities in a Registration Statement is a primary offering or not eligible to be made on a delayed or continuous basis under the provisions of Rule 415 under the 1933 Act, or requires any Investor to be named as an "underwriter," the Company shall use commercially reasonable efforts to advocate before the SEC its reasonable position that the offering contemplated by such Registration Statement is a valid secondary offering and not an offering "by or on behalf of the issuer" as defined in Rule 415 (a "Constructive Primary Offering") and that none of the Investors is an "underwriter." The Investors shall have the right to review and oversee any registration or matters pursuant to this Section 2(e), including participation in any meetings or discussions with the SEC regarding the SEC's position and to comment on any written submission made to the SEC with respect thereto. In the event that, despite the Company's commercially reasonable efforts, the SEC does not alter its position, the Company shall (i) remove from such Registration Statement such portion of the Registrable Securities (the "Cut Back Shares") and/or (ii) agree to such restrictions and limitations on the registration and resale of the Registrable Securities as the SEC may require to assure the Company's compliance with the requirements of Rule 415 (collectively, the "SEC Restrictions"); provided, however, that the Company shall not agree to name any Investor as an "underwriter" in such Registration Statement without the prior written consent of such Investor. Any cut-back imposed on the Investors pursuant to this Section 2(e) shall be allocated among the Investors on a pro rata basis and shall be applied first to any of the Registrable Securities of such Investor as such Investor shall designate, unless the SEC Restrictions otherwise require or provide or the Investors otherwise agree. The parties agree that the Company's delay or failure to have a Registration Statement declared effective due to the SEC taking the position that the offering is a Constructive Primary Offering shall not be a breach of any provision of this Agreement and no liquidated damages shall accrue as to any Cut Back Shares. From and after such date as the Company is able to effect the registration of such Cut Back Shares in accordance with any SEC Restrictions applicable to such Cut Back Shares (such date, the "Restriction Termination Date"), all of the provisions of this Section 2 (including the Company's obligations with respect to the filing of a Registration Statement and its obligations to use commercially reasonable efforts to have such Registration Statement declared effective within the time periods set forth herein and the liquidated damages provisions relating thereto) shall again be applicable to such Cut Back Shares; provided, however, (i) that the Filing Deadline and/or the Qualification Deadline, as applicable, for such Registration Statement including such Cut Back Shares shall be ten (10) Business Days after such Restriction Termination Date, and (ii) the date by which the Company is required to obtain effectiveness with respect to such Cut Back Shares under Section 2(c) shall be the 75th day immediately after the Restriction Termination Date (or the 110th day if the SEC reviews such Registration Statement).

3. Company Obligations. The Company will use commercially reasonable efforts to effect the registration of the Registrable Securities in accordance with the terms hereof, and pursuant thereto the Company will, as expeditiously as possible:

(a) use commercially reasonable efforts to cause such Registration Statement to become effective and to remain continuously effective for a period that will terminate upon the earlier of (i) the date on which all Registrable Securities covered by such Registration Statement, as amended from time to time, have been sold, and (ii) the date on which all Shares and Warrant Shares cease to be Registrable Securities (the "Effectiveness Period");

(b) prepare and file with the SEC such amendments and post-effective amendments to such Registration Statement and the related Prospectus as may be necessary to keep such Registration Statement effective for the Effectiveness Period and to comply with the provisions of the 1933 Act and the 1934 Act with respect to the distribution of all of the Registrable Securities covered thereby;

(c) provide copies to and permit each Investor to review each Registration Statement and all amendments and supplements thereto prior to their filing with the SEC and a reasonable opportunity to furnish comments thereon;

(d) furnish to each Investor whose Registrable Securities are included in any Registration Statement (i) promptly after the same is prepared and filed with the SEC, if requested by the Investor, one (1) copy of any Registration Statement and any amendment thereto, each preliminary prospectus and Prospectus and each amendment or supplement thereto, and each letter written by or on behalf of the Company to the SEC or the staff of the SEC, and each item of correspondence from the SEC or the staff of the SEC, in each case relating to such Registration Statement (other than any portion thereof which contains information for which the Company has sought confidential treatment), and (ii) such number of copies of a Prospectus, including a preliminary prospectus, and all amendments and supplements thereto and such other documents as each Investor may reasonably request in order to facilitate the disposition of the Registrable Securities owned by such Investor that are covered by such Registration Statement;

(e) use commercially reasonable efforts to (i) prevent the issuance of any stop order or other suspension of effectiveness and, (ii) if such order is issued, obtain the withdrawal of any such order at the earliest practical moment;

(f) use commercially reasonable efforts to cause all Registrable Securities covered by a Registration Statement to be listed on each securities exchange, interdealer quotation system or other market on which similar securities issued by the Company are then listed;

(g) promptly notify the Investors, at any time prior to the end of the Effectiveness Period, upon discovery that, or upon the happening of any event as a result of which, the Prospectus includes an untrue statement of a material fact or omits to state any material fact required to be stated therein or necessary to make the statements therein not misleading in light of the circumstances then existing (provided that such notice shall not, without the prior written consent of an Investor, disclose to such Investor any material nonpublic information regarding the Company), and promptly prepare, file with the SEC and furnish to such holder a supplement to or an amendment of such Prospectus as may be necessary so that such Prospectus shall not include an untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein not misleading in light of the circumstances then existing;

(h) otherwise use commercially reasonable efforts to comply with all applicable rules and regulations of the SEC under the 1933 Act and the 1934 Act, including, without limitation, Rule 172 under the 1933 Act, file any final Prospectus, including any supplement or amendment thereof, with the SEC pursuant to Rule 424 under the 1933 Act, promptly inform the Investors in writing if, at any time during the Effectiveness Period, the Company does not satisfy the conditions specified in Rule 172 and, as a result thereof, the Investors are required to deliver a Prospectus in connection with any disposition of Registrable Securities and take such other actions as may be reasonably necessary to facilitate the registration of the Registrable Securities hereunder; and make available to its security holders, as soon as reasonably practicable, an earnings statement covering satisfying the provisions of Section 11(a) of the 1933 Act;

(i) if requested by an Investor, the Company shall (i) as soon as practicable, incorporate in a prospectus supplement or post-effective amendment such information as an Investor reasonably requests to be included therein relating to the sale and distribution of Registrable Securities, including, without limitation, information with respect to the number of Registrable Securities being offered or sold, the purchase price being paid therefor and any other terms of the offering of the Registrable Securities to be sold in such offering; (ii) as soon as practicable, make all required filings of such prospectus supplement or post-effective amendment after being notified of the matters to be incorporated in such prospectus supplement or post-effective amendment; and (iii) as soon as practicable, supplement or make amendments to any Registration Statement if reasonably requested by an Investor holding any Registrable Securities;

(j) within two (2) Business Days after a Registration Statement which covers Registrable Securities is ordered effective by the SEC, the Company shall deliver to the transfer agent for such Registrable Securities (with copies to the Investors whose Registrable Securities are included in such Registration Statement) confirmation that such Registration Statement has been declared effective by the SEC;

(k) make available upon reasonable prior notice during normal business hours and for reasonable periods for inspection by the Investors and by any attorney, accountant or other agent retained by the Investors and who is reasonably acceptable to the Company (collectively, the "Inspectors"), all pertinent financial and other records and pertinent corporate documents and properties of the Company (collectively, the "Records") as may be reasonably necessary for the purpose of such review, and cause the Company's officers, directors and employees and the independent public accountants who have certified its financial statements to make themselves available to discuss the business of the Company and to supply all information reasonably requested by the Inspectors for the sole purpose of conducting initial and ongoing due diligence with respect to the Company and the accuracy of the Registration Statement; provided, however, that each Investor shall agree to, and to direct its Inspectors to, hold in strict confidence and shall not make any disclosure or use of any Record or other information which the Company determines in good faith to be confidential, and of which determination the Inspectors are so notified, unless (a) the disclosure of such Records is necessary to avoid or correct a misstatement or omission in any Registration Statement or is otherwise required under the 1933 Act, (b) the release of such Records is ordered pursuant to a final, non-appealable subpoena or order from a court or government body of competent jurisdiction, or (c) the information in such Records has been made generally available to the public other than by disclosure in violation of this Section 3(k). Notwithstanding the foregoing, the Company shall not disclose material nonpublic information to the Investors, or to advisors to or representatives of the Investors, unless prior to disclosure of such information the Company identifies such information as being material nonpublic information and provides the Investors, such advisors and such representatives with the opportunity to accept or refuse to accept such material nonpublic information for review and any Investor wishing to obtain such information enters into an appropriate confidentiality agreement with the Company with respect thereto; and

(l) with a view to making available to the Investors the benefits of Rule 144 (or its successor rule) and any other rule or regulation of the SEC that may at any time permit the Investors to sell shares of Common Stock to the public without registration, the Company covenants and agrees to: (i) make and keep adequate current public information available, as those terms are understood and defined in Rule 144, until the earlier of (A) six months after such date as all of the Registrable Securities may be sold without restriction by the holders thereof pursuant to Rule 144 or any other rule of similar effect or (B) such date as all of the Registrable Securities shall have been resold; (ii) file with the SEC in a timely manner all reports and other documents required of the Company under the 1934 Act; and (iii) furnish to each Investor upon request, as long as such Investor owns any Registrable Securities, (A) a written statement by the Company that it has complied with the reporting requirements of the 1934 Act, (B) a copy of the Company's most recent Annual Report on Form 10-K or Quarterly Report on Form 10-Q, and (C) such other information as may be reasonably requested in order to avail such Investor of any rule or regulation of the SEC that permits the selling of any such Registrable Securities without registration.

4. Obligations of the Investors.

(a) Notwithstanding any other provision of the Agreement, no Investor may include any of its Registrable Securities in the Registration Statement pursuant to this Agreement unless such Investor furnishes to the Company a completed questionnaire substantially in the form of Exhibit B (the "Questionnaire") for use in connection with the Registration Statement at least five (5) Business Days prior to the anticipated filing date of the Registration Statement if such Investor elects to have any of the Registrable Securities included in such Registration Statement. In addition to the Questionnaire, each Investor shall furnish such other information as shall be reasonably required to effect the registration of such Registrable Securities, and shall execute such documents in connection with such registration as the Company may reasonably request.

(b) Each Investor, by its acceptance of the Registrable Securities, agrees to cooperate with the Company as reasonably requested by the Company in connection with the preparation and filing of a Registration Statement hereunder, unless such Investor has notified the Company in writing of its election to exclude all of its Registrable Securities from such Registration Statement.

(c) Each Investor agrees that, upon receipt of any notice from the Company of either (i) the commencement of an Allowed Delay pursuant to Section 2(c)(ii) or (ii) the happening of an event pursuant to Section 3(g) hereof, such Investor will immediately discontinue disposition of Registrable Securities pursuant to any Registration Statement covering such Registrable Securities, until the Investor is advised by the Company that such dispositions may again be made, provided that, no Holder shall be required to discontinue disposition of Registrable Securities under a Registration Statement by virtue of the delivery by the Company of a notice of the occurrence of any event of the kind described in Section 2(c)(ii), on more than two occasions or for sixty (60) total calendar days, in each case during any twelve-month period, or for more than thirty (30) consecutive days.

(d) Each Investor covenants and agrees that it will comply with the prospectus delivery requirements of the 1933 Act as applicable to it or an exemption therefrom in connection with sales of Registrable Securities pursuant to any Registration Statement.

5. Indemnification.

(a) Indemnification by the Company. The Company will indemnify and hold harmless each Investor and its officers, directors, members, employees and agents, and each other person, if any, who controls such Investor within the meaning of the 1933 Act, against any losses, claims, damages or liabilities (collectively, "Losses"), joint or several, to which they may become subject under the 1933 Act or otherwise, insofar as such Losses (or actions in respect thereof) arise out of or are based upon (i) any untrue or alleged untrue statement of any material fact contained in any Registration Statement, any preliminary Prospectus or final Prospectus, or any amendment or supplement thereof, (ii) any omission or alleged omission of a material fact required to be stated therein or necessary to make the statements in any preliminary Prospectus or final Prospectus, or any amendment or supplement thereof, in light of the circumstances under which they were made not misleading or (iii) any violation or alleged violation by the Company or any of its subsidiaries of any federal, state, foreign or common law rule or regulation applicable to the Company or any of its subsidiaries and relating to action or inaction in connection with any such registration, disclosure document or other document or report, except to the extent that any such Losses arise out of or are based upon (x) an untrue statement or alleged untrue statement or omission or alleged omission so made in conformity with Investor Information, (y) the use by an Investor of an outdated or defective Prospectus after the Company has notified such Investor in writing that such Prospectus is outdated or defective; or (z) an Investor's failure to send or give a copy of the Prospectus or supplement (as then amended or supplemented), if required (and not exempted) to the Persons asserting an untrue statement or omission or alleged untrue statement or omission at or prior to the written confirmation of the sale of Registrable Securities.

(b) Indemnification by the Investors. Each Investor agrees, severally but not jointly, to indemnify and hold harmless, to the fullest extent permitted by law, the Company, its directors, officers, employees, stockholders and each person who controls the Company (within the meaning of the 1933 Act) against any Losses resulting from any untrue statement of a material fact or any omission of a material fact required to be stated in any Registration Statement or Prospectus or preliminary Prospectus or amendment or supplement thereto or necessary to make the statements therein not misleading, to the extent, but only to the extent that such untrue statement or omission is contained in any information furnished in writing by such Investor, relating to such Investor, to the Company specifically for inclusion in such Registration Statement or Prospectus or amendment or supplement thereto ("Investor Information"). In no event shall the liability of an Investor be greater in amount than the dollar amount of the proceeds (net of all expense paid by such Investor in connection with any claim relating to this Section 5 and the amount of any damages such Investor has otherwise been required to pay by reason of such untrue statement or omission) received by such Investor upon the sale of the Registrable Securities included in such Registration Statement giving rise to such indemnification obligation.

(c) Conduct of Indemnification Proceedings. Any person entitled to indemnification hereunder shall (i) give prompt written notice to the indemnifying party of any claim with respect to which it seeks indemnification and (ii) permit such indemnifying party to assume the defense of such claim with counsel reasonably satisfactory to the indemnified party; provided that any person entitled to indemnification hereunder shall have the right to employ separate counsel and to participate in the defense of such claim, but the fees and expenses of such counsel shall be at the expense of such person unless (a) the indemnifying party has agreed in writing to pay such fees or expenses, (b) the indemnifying party shall have failed to assume the defense of such claim and employ counsel reasonably satisfactory to such person or (c) in the reasonable judgment of any such person, based upon written advice of its counsel, a conflict of interest exists between such person and the indemnifying party with respect to such claims (in which case, if the person notifies the indemnifying party in writing that such person elects to employ separate counsel at the expense of the indemnifying party, the indemnifying party shall not have the right to assume the defense of such claim on behalf of such person); and provided, further, that the failure of any indemnified party to give written notice as provided herein shall not relieve the indemnifying party of its obligations hereunder, except to the extent that such failure to give notice shall materially adversely affect the indemnifying party in the defense of any such claim or litigation. It is understood that the indemnifying party shall not, in connection with any proceeding in the same jurisdiction, be liable for fees or expenses of more than one separate firm of attorneys at any time for all such indemnified parties. No indemnifying party will, except with the consent of the indemnified party, which consent shall not be unreasonably withheld, conditioned or delayed, consent to entry of any judgment or enter into any settlement that does not include as an unconditional term thereof the giving by the claimant or plaintiff to such indemnified party of a release from all liability in respect of such claim or litigation. No indemnified party will, except with the consent of the indemnifying party, which consent shall not be unreasonably withheld, conditioned or delayed, consent to entry of any judgment or enter into any settlement.

(d) Contribution. If for any reason the indemnification provided for in the preceding paragraphs (a) and (b) is unavailable to an indemnified party or insufficient to hold it harmless, other than as expressly specified therein, then the indemnifying party shall contribute to the amount paid or payable by the indemnified party as a result of such loss, claim, damage or liability in such proportion as is appropriate to reflect the relative fault of the indemnified party and the indemnifying party, as well as any other relevant equitable considerations. No person guilty of fraudulent misrepresentation within the meaning of Section 11(f) of the 1933 Act shall be entitled to contribution.

from any person not guilty of such fraudulent misrepresentation. In no event shall the contribution obligation of an Investor be greater in amount than the dollar amount of the proceeds (net of all expenses paid by such holder in connection with any claim relating to this Section 5 and the amount of any damages such holder has otherwise been required to pay by reason of such untrue or alleged untrue statement or omission or alleged omission) received by it upon the sale of the Registrable Securities giving rise to such contribution obligation.

6. Miscellaneous.

(a) Effective Date. This Agreement shall be effective as of the Closing, and if the Purchase Agreement is terminated in accordance with its terms, then this Agreement shall be null and void.

(b) Amendments and Waivers. This Agreement may be amended only by a writing signed by the Company and the Required Investors. The Company may take any action herein prohibited, or omit to perform any act herein required to be performed by it, only if the Company shall have obtained the written consent to such amendment, action or omission to act of the Required Investors.

(c) Notices. All notices and other communications provided for or permitted hereunder shall be made as set forth in Section 9.4 of the Purchase Agreement.

(d) Assignments and Transfers by Investors. The provisions of this Agreement shall be binding upon and inure to the benefit of the Investors and their respective successors and assigns. An Investor may transfer or assign, in whole or from time to time in part, to one or more persons its rights hereunder in connection with the transfer of Registrable Securities by such Investor to such person, provided that such Investor complies with all laws applicable thereto, and the provisions of the Purchase Agreement, and provides written notice of assignment to the Company promptly after such assignment is effected, and such person agrees in writing to be bound by all of the provisions contained herein.

(e) Assignments and Transfers by the Company. This Agreement may not be assigned by the Company (whether by operation of law or otherwise) without the prior written consent of the Required Investors, provided, however, that in the event that the Company is a party to a merger, consolidation, share exchange or similar business combination transaction in which the Common Stock is converted into the equity securities of another Person, from and after the effective time of such transaction, such Person shall, by virtue of such transaction, be deemed to have assumed the obligations of the Company hereunder, the term "Company" shall be deemed to refer to such Person and the term "Registrable Securities" shall be deemed to include the securities received by the Investors in connection with such transaction unless such securities are otherwise freely tradable by the Investors after giving effect to such transaction.

(f) Benefits of the Agreement. The terms and conditions of this Agreement shall inure to the benefit of and be binding upon the respective permitted successors and assigns of the parties. Nothing in this Agreement, express or implied, is intended to confer upon any party other than the parties hereto or their respective successors and assigns any rights, remedies, obligations, or liabilities under or by reason of this Agreement, except as expressly provided in this Agreement.

(g) Counterparts. This Agreement may be executed in two or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. Counterparts may be delivered via facsimile, electronic mail (including pdf or any electronic signatures complying with the U.S. federal ESIGN Act of 2000, e.g., www.docuSign.com) or other transmission method and any counterpart so delivered shall be deemed to have been duly and validly delivered and be valid and effective for all purposes.

(h) Titles and Subtitles. The titles and subtitles used in this Agreement are used for convenience only and are not to be considered in construing or interpreting this Agreement.

(i) Severability. Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof but shall be interpreted as if it were written so as to be enforceable to the maximum extent permitted by applicable law, and any such prohibition or unenforceability in any jurisdiction shall not invalidate or render unenforceable such provision in any other jurisdiction. To the extent permitted by applicable law, the parties hereby waive any provision of law which renders any provisions hereof prohibited or unenforceable in any respect.

(j) Further Assurances. The parties shall execute and deliver all such further instruments and documents and take all such other actions as may reasonably be required to carry out the transactions contemplated hereby and to evidence the fulfillment of the agreements herein contained.

(k) Governing Law. This Agreement shall be governed by, and construed in accordance with, the laws of the State of Delaware. Service of process in connection with any such suit, action or proceeding may be served on each party hereto anywhere in the world by the same methods as are specified for the giving of notices under this Agreement.

(l) Cumulative Remedies. The remedies provided herein are cumulative and not exclusive of any remedies provided by law.

[remainder of page intentionally left blank]

IN WITNESS WHEREOF, the parties have executed this Agreement or caused their duly authorized officers to execute this Agreement as of the date first above written.

COMPANY:

X4 PHARMACEUTICALS, INC.

By: /s/ Adam S. Mostafa
Name: Adam S. Mostafa
Title: Chief Financial Officer

[Signature Page to Registration Rights Agreement]

INVESTOR:
405 MSTV I LP

By: Tri Locum Partners LP as sub-advisor to 405 MSTV I LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

[Signature Page to Registration Rights Agreement]

INVESTOR:

New Holland Tactical Alpha Fund LP

By: Tri Locum Partners LP as sub-advisor to New Holland
Tactical Alpha Fund LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

[Signature Page to Registration Rights Agreement]

INVESTOR:

Tri Locum Healthcare Master Fund LP

By: Tri Locum Partners LP as Investment
Advisor to Tri Locum Healthcare Master
Fund LP

By: /s/ Jeff Miller
Name: Jeff Miller
Title: CFO

Notice to Investor (email preferred):
legal@trilocumpartners.com
Address for notice:
Tri Locum Partners LP
287 Park Avenue South, 2nd Fl
New York, NY 10010

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INVESTOR:

Stonepine Capital, LP

By: /s/ Timothy P. Lynch
Name: Timothy P. Lynch
Title: Managing Member of the GP

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INVESTOR:

**ORBIMED PRIVATE INVESTMENTS
IV, LP**

By: OrbiMed Capital GP IV LLC,
its General Partner

By: OrbiMed Advisors LLC,
its Managing Member

By: /s/ Carl Gordon
Name: Carl Gordon
Title: Member

[Signature Page to Registration Rights Agreement]

INVESTOR:

**CVI Investments, Inc., By: Heights Capital Management, Inc.,
its authorized agent**

By: /s/ Martin Kobinger
Name: Martin Kobinger
Title: President

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INVESTOR:

Adage Capital Partners LP

By: /s/ Dan Lehan

Name: Dan Lehan

Title: COO

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INVESTOR:

**INTEGRATED CORE STRATEGIES
(US) LLC**

By: Integrated Holding Group LP, its
Managing Member

By: Millennium Management LLC, its
General Partner

By: /s/ Mark Meskin
Name: Mark Meskin
Title: Chief Trading Officer

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INVESTOR:

Growth Equity Opportunities 18 VGE, LLC

By: NEA 18 VENTURE GROWTH EQUITY, L.P., its sole member

By: NEA PARTNERS VG 18, L.P., its general partner

By: NEA VG 18 GP, LLC, its general partner

By: /s/ Louis C. Citron
Name: Louis C. Citron
Title: Chief Legal Officer

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INVESTOR:

Lytton-Kambara Foundation

By: /s/ Laurence Lytton
Name: Laurence Lytton
Title: President

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INVESTOR:

**KINGDON HEALTHCARE MASTER
FUND, LP**

By: Kingdon Capital Management, LLC, as agent and investment
adviser

By: /s/ William Walsh
Name: William Walsh
Title: Chief Financial Officer

[Signature Page to Registration Rights Agreement]

INVESTOR:

**M. KINGDON OFFSHORE MASTER
FUND, LP**

By: Kingdon Capital Management, LLC,
as agent and investment adviser

By: /s/ William Walsh
Name: William Walsh
Title: Chief Financial Officer

[Signature Page to Registration Rights Agreement]

INVESTOR:

BCLS I Investco, LP

By: BCLS I Investco GP, LLC, its general partner

By: Bain Capital Life Sciences Fund, L.P., its manager

By: Bain Capital Life Sciences Partners, L.P., its general partner

By: Bain Capital Life Sciences Investors, LLC, its general partner

By: /s/ Andrew Hack

Name: Andrew Hack

Title: Partner

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INVESTOR:

BCLS II Investco, LP

By: BCLS II Investco (GP), LLC, its general partner

By: Bain Capital Life Sciences Fund II, L.P., its manager

By: Bain Capital Life Sciences Investors II, LLC, its general partner

By: Bain Capital Life Sciences Investors, LLC, its manager

By: /s/ Andrew Hack

Name: Andrew Hack

Title: Partner

[Signature Page to Registration Rights Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Asset Master, LTD**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Registration Rights Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Tax Efficient, LP**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Registration Rights Agreement]

INVESTOR:

**Empery Asset Management, LP, for the
benefit of Empery Tax Efficient III, LP**

By: /s/ Brett S. Director
Name: Brett S. Director
Title: General Counsel

[Signature Page to Registration Rights Agreement]

INVESTOR:

ACORN BIOVENTURES, L.P.

By: ACORN CAPITAL ADVISORS GP, LLC
Its: General Partner

By: /s/ Isaac Manke
Name: Isaac Manke
Title: Member

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INVESTOR:

ACORN BIOVENTURES 2, L.P.

By: ACORN CAPITAL ADVISORS 2 GP, LLC
Its: General Partner

By: /s/ Isaac Manke
Name: Isaac Manke
Title: Member

[Signature Page to Registration Rights Agreement]

INVESTOR:

CITADEL CEMF INVESTMENTS LTD.

By: Citadel Advisors LLC, its portfolio manager

By: /s/ Christopher L. Ramsay
Name: Christopher L. Ramsay
Title: Authorized Signatory

[Signature Page to Registration Rights Agreement]

INVESTOR:

Parkman HP Master Fund LP

By: /s/ Gregory Martinez
Name: Gregory Martinez
Title: Managing Member, GP

[Signature Page to Registration Rights Agreement]

INVESTOR:

Schonfeld EXT Master Fund LP

By: /s/ Trina Geatz
Name: Trina Geatz
Title: Deputy Chief Operating Officer

[Signature Page to Registration Rights Agreement]

EXHIBIT A

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 the selling stockholders as a gift, pledge, partnership distribution or other transfer, may, from time to time, sell, transfer or otherwise dispose of any or all of its 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 the selling stockholders and, if the selling stockholders default in the performance of its 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 selling stockholders list 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).

The aggregate proceeds to the selling stockholders from the sale of the common stock offered by the selling stockholders will be the purchase price of the common stock less discounts or commissions, if any. The selling stockholders reserves the right to accept and, together with its 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 \$0.001 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 the selling stockholders meet the criteria and conforms to the requirements of that rule.

To the extent required, the shares of our common stock to be sold, the name of the selling stockholders, the respective purchase price and public offering price, the names of any agents or dealers, 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 its 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.

EXHIBIT B

FORM OF

SELLING SECURITYHOLDER QUESTIONNAIRE

Reference is made to that certain registration rights agreement (the "*Registration Rights Agreement*"), dated as of May 15, 2023, by and among X4 Pharmaceuticals, Inc. (the "*Company*"), and the Investors named therein. Capitalized terms used and not defined herein shall have the meanings given to such terms in the Registration Rights Agreement.

The undersigned Holder (the "*Selling Securityholder*") of the Registrable Securities is providing this Selling Securityholder Questionnaire pursuant to Section 4(a) of the Registration Rights Agreement. The Selling Securityholder, by signing and returning this Selling Securityholder Questionnaire, understands that it will be bound by the terms and conditions of this Selling Securityholder Questionnaire and the Registration Rights Agreement. The Selling Securityholder hereby acknowledges its indemnity obligations pursuant to Section 5(b) of the Registration Rights Agreement.

The Selling Securityholder provides the following information to the Company and represents and warrants that such information is accurate and complete:

- (1)
 - (a) Full Legal Name of Selling Securityholder:

 - (b) Full Legal Name of Registered Holder (if not the same as (a) above) through which Registrable Securities listed in (3) below are held:

 - (c) Full Legal Name of DTC Participant (if applicable and if not the same as (b) above) through which Registrable Securities listed in (3) below are held:

- (2) Address for Notices to Selling Securityholder:

Telephone (including area code):

Fax (including area code):

Contact Person:

- (3) Beneficial Ownership of Registrable Securities:
 - (a) Type and Principal Amount/Number of Registrable Securities beneficially owned:

 - (b) CUSIP No(s). of such Registrable Securities beneficially owned:

- (4) Beneficial Ownership of Other Securities of the Company Owned by the Selling Securityholder:

Except as set forth below in this Item (4), the Selling Securityholder is not the beneficial or registered owner of any securities of the Company other than the Registrable Securities listed above in Item (3).

(a) Type and Amount of Other Securities beneficially owned by the Selling Securityholder:

(b) CUSIP No(s). of such Other Securities beneficially owned:

(5) Relationship with the Company:

Except as set forth below, neither the Selling Securityholder nor any of its affiliates, officers, directors or principal equity holders (5% or more) has held any position or office or has had any other material relationship with the Company (or its predecessors or affiliates) during the past three years.

State any exceptions here:

(6) Is the Selling Securityholder a registered broker-dealer?

Yes

No

If "Yes", please answer subsection (a) and subsection (b):

(a) Did the Selling Securityholder acquire the Registrable Securities as compensation for underwriting/broker-dealer activities to the Company?

Yes

No

(b) If you answered "No" to question 6(a), please explain your reason for acquiring the Registrable Securities:

(7) Is the Selling Securityholder an affiliate of a registered broker-dealer?

Yes

No

If "Yes", please identify the registered broker-dealer(s), describe the nature of the affiliation(s) and answer subsection (a) and subsection (b):

(a) Did the Selling Securityholder purchase the Registrable Securities in the ordinary course of business (if no, please explain)?

Yes

No

(b) Did the Selling Securityholder have an agreement or understanding, directly or indirectly, with any person to distribute the Registrable Securities at the same time the Registrable Securities were originally purchased (if yes, please explain)?

Yes

No

(8) Is the Selling Securityholder a non-public entity?

Yes

No

If "Yes", please answer subsection (a):

(a) Identify the natural person or persons that have voting or investment control over the Registrable Securities that the non-public entity owns:

(9) Plan of Distribution:

The Selling Securityholder (including its transferees, donees, pledgees and other successors in interest) intends to distribute the Registrable Securities listed above in Item (3) pursuant to the Registration Statement in accordance with the Plan of Distribution attached as Exhibit A to the Registration Rights Agreement .

The Selling Securityholder acknowledges that it understands its obligations to comply with the provisions of the Securities Exchange Act of 1934, as amended, and the rules thereunder relating to stock manipulation, particularly Regulation M thereunder (or any successor rules or regulations), in connection with any offering of Registrable Securities pursuant to the Shelf Registration Agreement. The Selling Securityholder agrees that neither it nor any person acting on its behalf will engage in any transaction in violation of such provisions.

Pursuant to the Registration Rights Agreement, the Company has agreed under certain circumstances to indemnify the Selling Securityholder against certain liabilities.

In the event the Selling Securityholder transfers all or any portion of the Registrable Securities listed in Item (3) above after the date on which such information is provided to the Company other than pursuant to the Registration Statement, the Selling Securityholder agrees to notify the transferee(s) at the time of the transfer of its rights and obligations under this Selling Securityholder Questionnaire and the Registration Rights Agreement.

In accordance with the Selling Securityholder's obligation under the Registration Rights Agreement to provide such information as may be required by law or by the staff of the SEC for inclusion in the Registration Statement, the Selling Securityholder agrees to promptly notify the Company of any inaccuracies or changes in the information provided herein that may occur subsequent to the date hereof at anytime while the Registration Statement remains effective. All notices to the Selling Securityholder pursuant to the Registration Rights Agreement shall be made as set forth in Section 9.4 of the Securities Purchase Agreement.

By signing below, the Selling Securityholder consents to the disclosure of the information contained herein in its answers to Items (1) through (9) above and the inclusion of such information in the Registration Statement and the related Prospectus. The undersigned understands that such information will be relied upon by the Company in connection with the preparation or amendment of the Registration Statement and the related Prospectus.

By signing below, the undersigned agrees that if the Company notifies the undersigned that the Registration Statement is not available pursuant to the terms of the Registration Rights Agreement, the undersigned will suspend use of the Prospectus until notice from the Company that the Prospectus is again available.

Once this Selling Securityholder Questionnaire is executed by the undersigned and received by the Company, the terms of this Selling Securityholder Questionnaire, and the representations, warranties and agreements contained herein, shall be binding on, shall inure to the benefit of and shall be enforceable by the respective successors, heirs, personal representatives, and assigns of the Company and the undersigned with respect to the Registrable Securities

beneficially owned by the undersigned and listed in Item (3) above. This Selling Securityholder Questionnaire shall be governed by and construed in accordance with the laws of the State of Delaware.

IN WITNESS WHEREOF, the undersigned, by authority duly given, has caused this Selling Securityholder Questionnaire to be executed and delivered either in person or by its duly authorized agent.

Dated: _____

Beneficial Owner

By:

Name:

Title:

PLEASE RETURN THE COMPLETED AND EXECUTED
SELLING SECURITYHOLDER QUESTIONNAIRE TO THE COMPANY AT:
[.]



Exhibit 99.1

X4 Pharmaceuticals Announces \$65 Million Private Placement Priced At-the-Market

X4 WHIM Phase 3 clinical data webinar to be held today at 4 pm ET

BOSTON, Mass., May 16, 2023 - [X4 Pharmaceuticals, Inc.](#) (Nasdaq: XFOR), a leader in the discovery and development of novel small molecule therapeutics to benefit people with rare diseases of the immune system, today announced that it has agreed to sell an aggregate of 42,784,203 shares of common stock (or pre-funded warrants in lieu thereof) to certain institutional accredited investors in a private investment in public equity (PIPE) financing. X4 anticipates that gross proceeds from the PIPE will be approximately \$65 million, before deducting fees to the placement agents and other estimated offering expenses payable by the Company. The closing of the financing is expected to occur on or about May 18, 2023, subject to customary closing conditions.

In addition, as previously announced, X4 will present additional results from its global, pivotal, Phase 3 clinical trial (4WHIM) evaluating the safety and efficacy of mavorixafor in people with WHIM syndrome at a company webinar to be held today, May 16, 2023, at 4:00 p.m. ET. The live webinar can be accessed [here](#). The webcast can also be accessed on the investor relations section of X4's website at www.x4pharma.com.

The PIPE financing included participation from new and existing investors including New Enterprise Associates (NEA), Bain Capital Life Sciences, Adage Capital Management, Stonepine Capital Management, LLC, Acorn Bioventures, OrbiMed, Kingdon Capital, and other healthcare specialist investors.

Piper Sandler and Stifel served as lead placement agents. Cantor acted as co-placement agent and H.C. Wainwright & Co. acted as financial advisor for the offering.

Inclusive of the net proceeds from this transaction, X4 now expects its cash and cash equivalents to fund operations into the fourth quarter of 2024, excluding the potential proceeds from the sale of a priority review voucher, for which the company is eligible and may receive in the first half of 2024.

Pursuant to the terms of the securities purchase agreement, at the closing of the PIPE, X4 will issue an aggregate of 42,784,203 shares of common stock (or pre-funded warrants in lieu thereof). The purchase price per share is \$1.52 (or \$1.519 per pre-funded warrant). The price per share was based in part upon the Nasdaq official closing price.

X4 expects to use these funds for continued clinical development and commercial readiness of its lead candidate, mavorixafor, and for working capital, and general corporate purposes.

The securities sold in this financing are being made in a transaction not involving a public offering and have not been registered under the Securities Act of 1933, as amended, and may not be offered or sold in the United States except pursuant to an effective registration statement or an applicable exemption from the registration requirements. X4 has agreed to file a registration statement with the Securities and Exchange Commission registering the resale of the shares of common stock and the shares of its common stock underlying the pre-funded warrants sold in this financing.

This press release shall not constitute an offer to sell or a solicitation of an offer to buy these securities, nor shall there be any sale of these securities in any state or other jurisdiction in which such offer, solicitation or sale would be unlawful prior to the registration or qualification under the securities laws of any such state or other jurisdiction.

About X4 Pharmaceuticals

X4 Pharmaceuticals is a late-stage clinical biopharmaceutical company focused on the discovery and development of novel therapies for people with rare diseases of the immune system. Our lead clinical candidate is mavorixafor, a small molecule antagonist of chemokine receptor CXCR4 that is being developed as an oral, once-daily therapy. Due to its ability to increase the mobilization of mature, functional white blood cells from the bone marrow into the bloodstream, we believe that mavorixafor has the potential to provide therapeutic benefit across a variety of chronic neutropenic disorders, including WHIM (Warts, Hypogammaglobulinemia, Infections, and Myelokathexis) syndrome, a rare, primary immunodeficiency. Following announcement of positive top-line data from our global, pivotal, 4WHIM Phase 3 clinical trial, we are currently preparing a U.S. regulatory submission seeking approval of oral, once-daily mavorixafor in the treatment of people aged 12 years and older with WHIM syndrome. We are also currently evaluating mavorixafor in a Phase 2 clinical trial in people with certain chronic neutropenic disorders following positive results from a Phase 1b clinical trial of mavorixafor in people with congenital, idiopathic, or cyclic neutropenia. We continue to leverage our insights into CXCR4 and immune system biology at our corporate headquarters in Boston, Massachusetts and at our research center of excellence in Vienna, Austria. For more information, please visit our website at www.x4pharma.com.

Forward-Looking Statements

This press release contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, as amended. These statements may be identified by the words "may," "will," "could," "would," "should," "expect," "plan," "anticipate," "intend," "believe," "estimate," "predict," "project," "potential," "continue," "target," or other similar terms or expressions that concern X4's expectations, strategy, plans, or intentions. Forward-looking statements include, without limitation, statements regarding the timing, use of proceeds and closing of the PIPE. Actual events or results may differ materially from those expressed or implied by any forward-looking statements contained herein, including, without limitation, as a result of market and other conditions; the risk that the conditions to the closing of the proposed PIPE are not satisfied; as well as other risks and uncertainties described in the section entitled "Risk Factors" in X4's Quarterly Report on Form 10-Q filed with the Securities and Exchange Commission on May 4, 2023, and in other filings X4 makes with the SEC from time to time. X4 undertakes no obligation to update the information contained in this press release to reflect new events or circumstances, except as required by law.

Contacts:

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Cherilyn Cecchini, M.D. (media)
LifeSci Communications
cecchini@lifescicomms.com



Exhibit 99.2

X4 Pharmaceuticals Announces Positive Phase 3 Results Showing Mavorixafor Reduced the Rate, Severity, and Duration of Infections vs. Placebo in Participants Diagnosed with WHIM Syndrome

~60% reduction in annualized infection rate seen in the mavorixafor arm vs. placebo ($p < 0.01$)

>75% reduction in the percentage of individuals experiencing severe infections (Grade 3 or higher) in the mavorixafor group vs. placebo group

>70% reduction in mean total days with infections (2 weeks on mavorixafor treatment vs. 7 weeks on placebo)

Company on track to submit NDA for mavorixafor early in 2H 2023 following completion of pre-NDA meeting with FDA

X4 webinar today at 4 pm ET to include live Q&A with clinical experts

BOSTON, May 16, 2023 -- **X4 Pharmaceuticals, Inc.** (Nasdaq: XFOR), a leader in the discovery and development of novel small molecule therapeutics to benefit patients with rare diseases of the immune system, is hosting a webinar today highlighting new data from its global, pivotal, 4WHIM Phase 3 clinical trial of once-daily, oral mavorixafor in individuals with WHIM syndrome. Following the [announcement](#) of positive top-line data from the 4WHIM trial in November 2022, today's event focuses on the impact of mavorixafor on the rate, severity, and duration of infections in trial participants.

"Today, we're announcing that mavorixafor treatment demonstrated statistically significant and clinically meaningful improvements across a number of key infection metrics versus placebo in our pivotal, Phase 3 trial in those diagnosed with WHIM Syndrome," said Paula Ragan, Ph.D., President and Chief Executive Officer of X4 Pharmaceuticals. "Given that frequent, severe, and long-lasting infections remain the most challenging burden for individuals with WHIM syndrome, we believe that demonstration of these clinical benefits in the 4WHIM trial are an important step in delivering a much-needed breakthrough for patients and their caregivers. We look forward to these data being presented at the upcoming annual meetings of the Clinical Immunology Society (CIS) and the European Hematology Association (EHA)." Dr. Ragan added, "We recently completed our pre-NDA meeting with the FDA and remain on track to submit for U.S. approval of mavorixafor for WHIM syndrome early in the second half of 2023."

Dr. Ragan concluded: "While we remain committed to delivering for the WHIM community, these meaningful results from the 4WHIM trial further bolster our commitment to advancing mavorixafor as quickly as possible as a potential treatment for the estimated 50,000 patients in the U.S. diagnosed with idiopathic, cyclic, and congenital chronic neutropenia (CN). We continue to look forward to delivering on our key CN milestones in the second or third quarter of 2023."

Key highlights from today's event include:

- **Rate of Infections:** In the trial, mavorixafor treatment resulted in a statistically significant reduction (~60%) in annualized infection rate versus placebo ($p < 0.01$). In addition, the data showed that the reduction was greater with time on treatment, with participants on mavorixafor experiencing less than one infection per year versus 4.5 for those on placebo; during the second 6 months of the trial, the difference also achieved statistical significance ($p < 0.005$).
- **Severity of Infections:** During the trial, 29% (5 of 17) of those on placebo experienced Grade 3 or higher infections, whereas only 7% (1 of 14) of those on mavorixafor experienced a Grade 3 or higher infection, equating to a 75% reduction in the number of individuals experiencing severe infections. Importantly, the single Grade 3 infection in the mavorixafor treatment arm occurred during the first 3 months of the trial; after 3 months of treatment, there were no serious infections in the mavorixafor-arm, whereas the frequency of severe infections in those on placebo remained unchanged over the 52-week trial period.
- **Duration of Infections:** In the trial, mavorixafor treatment reduced the total duration (in days) of infections by more than 70% as compared to placebo, with those on placebo experiencing a mean of 7 weeks (49.1 days) with infections over the 52-week trial period versus a mean of only 2 weeks (14.1 days) with infections for those treated with mavorixafor.
- **Other Infection Metrics:** Mavorixafor treatment resulted in a 40% lower total infection score, a metric that combines infection number and severity (LS mean [95% CI]: mavorixafor, 7.41 [1.64-13.19]; placebo, 12.27 [7.24-17.30]). Treatment with mavorixafor also resulted in reductions in upper and lower respiratory tract and skin infections compared with those on placebo; participants on placebo required greater medical intervention, with 10 of the 17 participants on placebo requiring treatment with antibiotics over the course of the study, versus 3 of the 14 receiving mavorixafor; and slight improvements in warts were demonstrated both in the mavorixafor and placebo arms (no difference between arms).
- **Safety and Tolerability:** As reported previously, mavorixafor was generally well tolerated in the 4WHIM trial, with no drug-related serious adverse events, no treatment limiting toxicities, and no discontinuations due to safety. Approximately 90% of participants in the trial continued on to receive mavorixafor treatment in the ongoing open-label extension study.

A late-breaking abstract of these data was accepted for oral presentation at the annual meeting of the Clinical Immunology Society (CIS) taking place May 18-21, 2023 in St. Louis, MO. Dr. Raffaele Badolato, Professor of Pediatrics at the University of Brescia (Italy) and an investigator in the 4WHIM clinical trial, will present at 11:30 am CT on Sunday, May 21st. Although the session is only accessible live to conference attendees, the company will post the presentation slides to its website concurrent with the presentation.

In addition, X4 is also announcing today that its submitted abstract of these data was accepted for oral presentation at the annual meeting of the European Hematology Association (EHA), taking place June 8-15, 2023 in Frankfurt, Germany. Dr. Jean Donadieu, Pediatrician in the Hemato Oncologic Department of Trousseau Hospital (Paris), Coordinator of the French Histiocytosis Registry, Coordinator of the pediatric branch of the French Histiocytosis Reference Center, and also an investigator in the 4WHIM clinical trial, will be delivering an encore oral presentation of the results being presented at CIS.

Investor Event Details:

The X4 live-event webcast presentation and the accompanying slides are now accessible on the investor relations section of the X4 website at www.x4pharma.com. Following the completion of the event, a replay will be available on the website.

About Mavorixafor and WHIM Syndrome

WHIM (warts, hypogammaglobulinemia, infections, and myelokathexis) syndrome is a rare, inherited, combined immunodeficiency disease caused by reduced mobilization and trafficking of white blood cells from the bone marrow due to over-signaling of the CXCR4/CXCL12 pathway. People with WHIM syndrome characteristically have very low blood levels of neutrophils (neutropenia) and lymphocytes (lymphopenia), and as a result, experience frequent, recurrent infections with a high risk of lung disease, refractory warts from underlying human papillomavirus (HPV) infection, limited antibody production due to low levels of immunoglobulin, and an increased risk of developing certain types of cancer. Mavorixafor is an investigational small-molecule antagonist of CXCR4 being developed as a once-daily oral therapy to correct the dysfunction resulting from the underlying causes of WHIM. For the WHIM indication, mavorixafor has been granted Breakthrough Therapy Designation, Fast Track Designation, and Rare Pediatric Designation in the U.S., and Orphan Drug Status in both the U.S. and European Union. Should mavorixafor be approved in the U.S. for the indication of WHIM syndrome, X4 could be eligible to receive a Priority Review Voucher (PRV).

About the 4WHIM Phase 3 Clinical Trial

The 4WHIM Phase 3 clinical trial was a global, randomized, double-blind, placebo-controlled, multicenter study designed to evaluate the efficacy and safety of oral, once-daily mavorixafor in people with genetically confirmed WHIM syndrome. Originally designed to enroll 18-28 patients, the trial enrolled 31 patients aged 12 and older who received either 400 mg mavorixafor (n=14) or placebo (n=17) orally once daily for 52 weeks. An open-label extension phase of the clinical trial is ongoing.

About X4 Pharmaceuticals

X4 Pharmaceuticals is a late-stage clinical biopharmaceutical company focused on the discovery and development of novel therapies for people with rare diseases of the immune system. Our lead clinical candidate is mavorixafor, a small molecule antagonist of chemokine receptor CXCR4 that is being developed as an oral, once-daily therapy. Due to its ability to increase the mobilization of mature, functional white blood cells from the bone marrow into the bloodstream, we believe that mavorixafor has the potential to provide therapeutic benefit across a variety of chronic neutropenic disorders, including WHIM (Warts, Hypogammaglobulinemia, Infections, and Myelokathexis) syndrome, a rare, primary immunodeficiency. Following announcement of positive top-line data from our global, pivotal, 4WHIM Phase 3 clinical trial, we are currently preparing a U.S. regulatory submission seeking approval of oral, once-daily mavorixafor in the treatment of people aged 12 years and older with WHIM syndrome. We are also currently evaluating mavorixafor in a Phase 2 clinical trial in people with certain chronic neutropenic disorders following positive results from a Phase 1b clinical trial of mavorixafor in people with congenital, idiopathic, or cyclic neutropenia. We continue to leverage our insights into CXCR4 and immune system biology at our corporate headquarters in Boston, Massachusetts and at our research center of excellence in Vienna, Austria. For more information, please visit our website at www.x4pharma.com.

Forward-Looking Statements

This press release contains forward-looking statements within the meaning of applicable securities laws, including the Private Securities Litigation Reform Act of 1995, as amended. These statements may be identified by the words "may," "will," "could," "would," "should," "expect," "plan," "anticipate," "intend," "believe," "estimate," "predict," "project," "potential," "continue," "target," or other similar terms or expressions that concern X4's expectations, strategy, plans, or intentions. Forward-looking statements include, without limitation, statements regarding the clinical progress of X4's pipeline development programs, including the anticipated New Drug Application submission for mavorixafor for

the treatment of WHIM syndrome and the timing thereof. Any forward-looking statements in this press release are based on management's current expectations and beliefs. Actual events or results may differ materially from those expressed or implied by any forward-looking statements contained herein, including, without limitation, on account of uncertainties inherent in the initiation and completion of clinical trials and clinical development; the risk that trials and studies may not have satisfactory outcomes; the risk that the outcomes of preclinical studies or earlier clinical trials will not be predictive of later clinical trial results; the risk that initial or interim results from a clinical trial may not be predictive of the final results of the trial or the results of future trials; the potential adverse effects arising from the testing or use of mavoxixafor or other product candidates; the risk that the U.S. Food and Drug Administration (FDA) may not accept a regulatory submission for mavoxixafor; the risk that the FDA may not approve mavoxixafor for WHIM syndrome; the risks related to X4's ability to raise additional capital; the impacts of general macroeconomic and geopolitical conditions, rising inflation, and uncertain credit and financial markets on X4's business, clinical trials, and financial position; and other risks and uncertainties, including those described in the section entitled "Risk Factors" in X4's Quarterly Report on Form 10-Q filed with the Securities and Exchange Commission (SEC) on May 4, 2023, and in other filings X4 makes with the SEC from time to time. X4 undertakes no obligation to update the information contained in this press release to reflect new events or circumstances, except as required by law.

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PROGRESS **4** PATIENTS

A Deeper Dive into Mavorixafor Phase 3 Data and
Unmet Patient Needs in WHIM Syndrome

May 16, 2023



Forward-Looking Statements

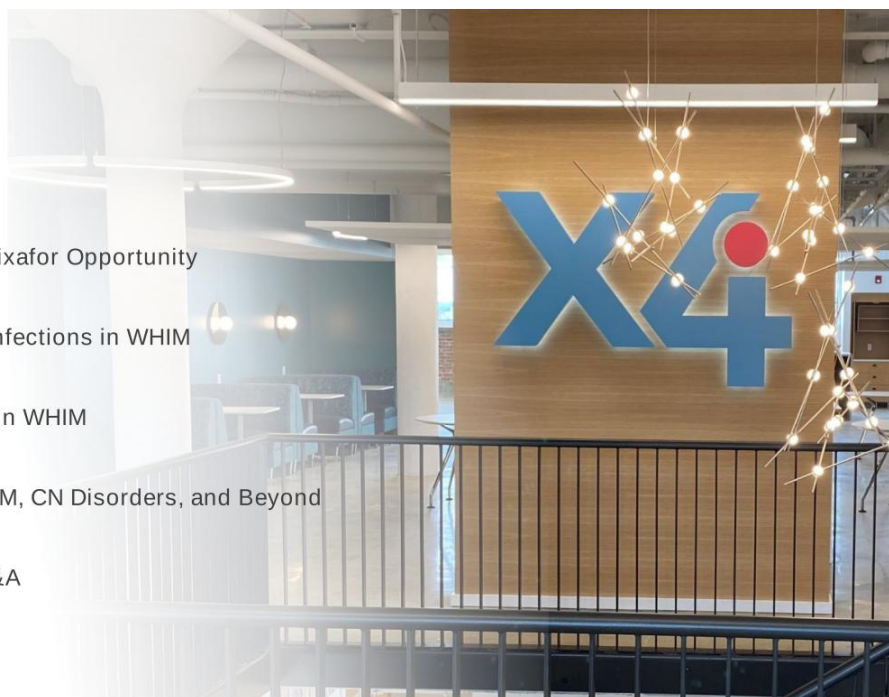
This presentation contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, as amended. These statements may be identified by the words "may," "will," "could," "would," "should," "expect," "plan," "anticipate," "intend," "believe," "estimate," "predict," "project," "potential," "continue," "target," or other similar terms or expressions that concern X4's expectations, strategy, plans, or intentions. Forward-looking statements include, without limitation, statements regarding the clinical development and therapeutic potential of mavorixafor for the treatment of WHIM syndrome, chronic and other neutropenias, and of X4's other product candidates; X4's possible exploration of additional opportunities for mavorixafor; the expected duration of patent protection; the expected availability, content, and timing of clinical data from X4's ongoing clinical trials of mavorixafor; anticipated regulatory filings; clinical trial design; patient prevalence; and market opportunities.

Any forward-looking statements in this presentation are based on management's current expectations and beliefs. Actual events or results may differ materially from those expressed or implied by any forward-looking statements contained herein on account of many factors, including, without limitation, uncertainties inherent in the initiation and completion of preclinical studies and clinical trials and clinical development; the risk that trials and studies may be delayed and may not have satisfactory outcomes; the risk that the outcomes of preclinical studies or earlier clinical trials will not be predictive of later clinical trial results; the risk that initial or interim results from a clinical trial may not be predictive of the final results of the trial or the results of future trials; the potential adverse effects arising from the testing or use of mavorixafor or other product candidates; the risk that patient prevalence, market, or opportunity estimates may be inaccurate; the impacts of general macroeconomic and geopolitical conditions on X4's business; risks related to X4's ability to raise additional capital; risks related to the substantial doubt about X4's ability to continue as a going concern; changes in expected or existing competition; changes in the regulatory environment; the uncertainties and timing of the regulatory approval process; unexpected litigation or other disputes; and other risks and uncertainties, including those described in the section entitled "Risk Factors" described in X4's most recent Form 10-Q filed with the Securities and Exchange Commission (SEC) on May 4, 2023.

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Today's Agenda

- 01 Welcome
- 02 Overview of Mavorixafor Opportunity
- 03 The Challenge of Infections in WHIM
- 04 New Phase 3 Data in WHIM
- 05 Path Forward: WHIM, CN Disorders, and Beyond
- 06 Conclusion and Q&A



Today's Event Participants



Charlotte Cunningham-Rundles, MD, PhD
Professor of Pediatric Immunology, Icahn School of Medicine at Mount Sinai



Jean Donadieu, MD, PhD
Pediatric Heme-Oncology, Chronic Neutropenia Registry Coordinator
Trousseau Hospital, Paris



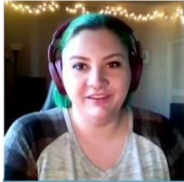
Peter Newburger, MD
Professor of Pediatrics, Molecular, Cell, & Cancer Biology at UMass Chan Medical School



Akiko Shimamura, MD, PhD
Professor of Pediatrics at Harvard Medical School, Director Bone Marrow & MDS Program at Boston Children's



Teresa Tarrant, MD, FAAAAI
Assoc. Professor at Duke School of Medicine, Vice Chair, Translational Research
Rheumatology, Immunology



Gabrielle
Diagnosed with WHIM



Willow
Diagnosed with WHIM



Courtney
Diagnosed with WHIM



Paula Ragan, PhD
X4 President & CEO



Murray Stewart, DM, FRCP
X4 Interim CMO

Mavorixafor: Potential Breakthrough for Treating Chronic Neutropenic Disorders

Only oral candidate in development to treat CN disorders, including WHIM syndrome

- ✓ Proven mechanism of action (MOA) / ability to increase white blood cells, including neutrophils
- ✓ Demonstrated tolerability in >200 individuals, some for >4 years
- ✓ Breakthrough Therapy Designation (BTD) and Orphan Drug Designation in first indication: WHIM syndrome; Priority Review Voucher (PRV) eligible
- ✓ Patent protection expected through 2038



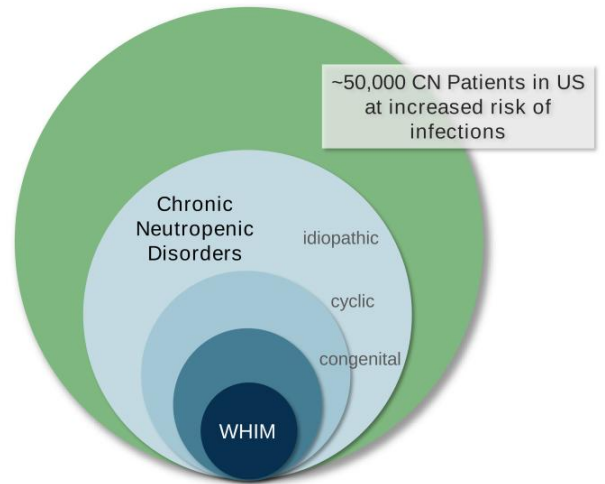
Mavorixafor's Market Potential: Addressing Infection Risk in CN and Beyond

Chronic Neutropenic (CN) Disorders

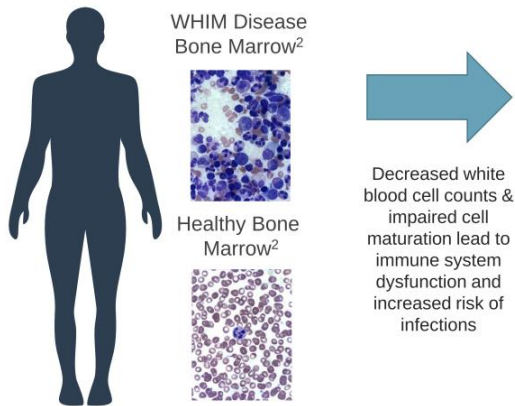
- Increased risk of serious infections
- Neutropenia
- ~50,000 estimated US patients¹

WHIM Syndrome

- Increased risk of serious infections
- Neutropenia and lymphopenia
- >1,000 estimated US patients²



WHIM¹ Syndrome: Poorly Functioning Immune System, Starting from Birth
Clinical diagnosis driven by over-signaling in the CXCL12/CXCR4 pathway



Increased Risk of Infections

The infographic features a central silhouette of a human figure. Surrounding it are four circular images illustrating infection sites: lungs (respiratory tract), heart (endocarditis), skin (cellulitis), and genital area (HPV-related cancers). Text labels identify these areas: 'Ear, Sinus, and Lung: Upper/Lower Respiratory Tract Infections', 'Heart: Endocarditis', 'Skin: Cellulitis', and 'Genitourinary Areas: HPV-related Cancers'.

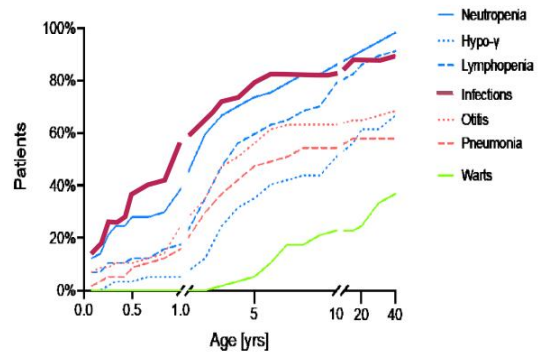
1. WHIM = Warts, Hypogammaglobulinemia, Infections and Myelokathexis
2. McDermott: Stiehm's Immune Deficiencies 2014, Pages 711-719

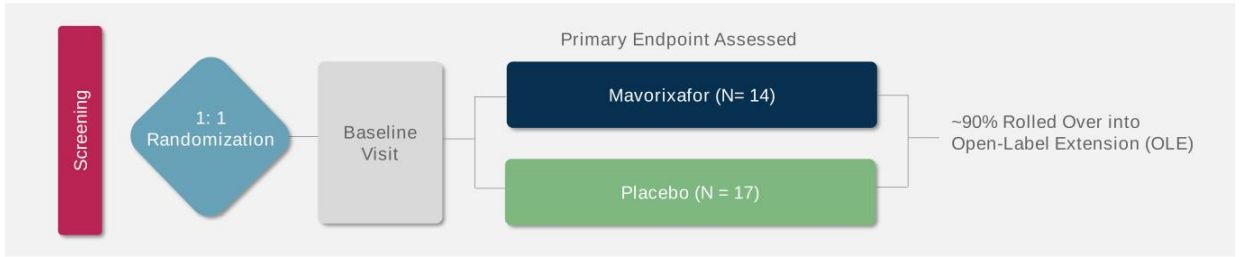
7

Infection Risk Tracks with Neutropenia in WHIM Syndrome

- Infections start within the first year of life
- Neutropenia tracks with infection risk from birth and continues as patients age
- Most patients have both neutropenia and infections by the second decade of life

Relationship Between Neutropenia & Infections in WHIM Syndrome Natural History





Baselines: 100% of patients had severe chronic neutropenia (median ANC ~200 cells/ μ L) and chronic lymphopenia (median ALC ~500 cells/ μ L)

Primary & First Secondary Endpoint: Time above Threshold (TAT) for ANC and ALC calculated as mean of the 13, 26, 39, and 52-week

Infection-Related Assessments: Data reviewed by blinded, centralized, independent adjudication committee for rate, severity, duration

Safety Assessments: Throughout the 52-weeks by an independent Data Safety Monitoring Board

GOAL LABEL: Indicated for the treatment of people aged 12 and above diagnosed with WHIM syndrome



Phase 3 Clinical Trial

Mavorixafor

demonstrated significant clinical benefit & favorable safety profile

Reduced
RATE
of infections

Reduced
SEVERITY
of infections

Reduced
DURATION
of infections

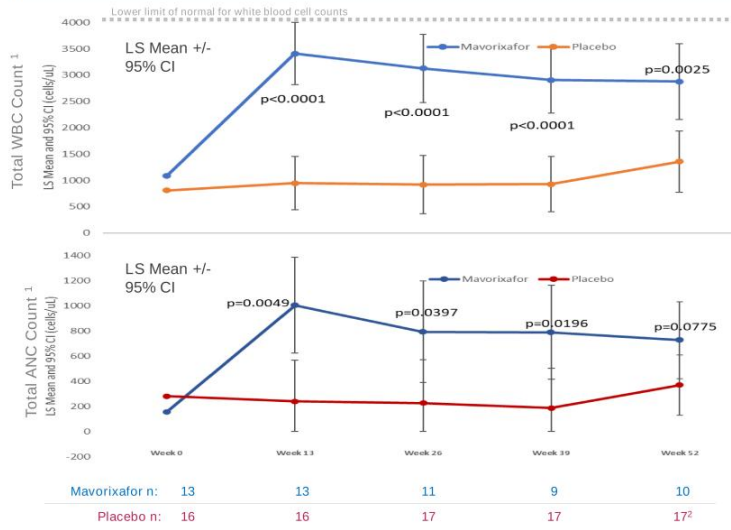
4WHIM trial met primary endpoint of time above threshold for absolute neutrophil counts (TAT_{ANC}) and key clinical benefit assessments

Mavorixafor achieved statistically significant increases in all white blood cells – neutrophils, lymphocytes, & monocytes – versus placebo



Mavorixafor MOA Proven

Statistically Significant Increases in Total White Blood Cell (WBC) and Absolute Neutrophil Counts (ANC) over the 52 Week Study



Increased Cell Counts

- Statistically significant, durable increases in WBC and ANC
- Absolute WBCs approach near normal levels
- Statistically significant, durable increases in all WBC subtypes³
 - Absolute Neutrophil Count (ANC)
 - Absolute Lymphocyte Count (ALC)
 - Absolute Monocyte Count (AMC)

1. Calculated as the mean of absolute cell counts over the 24-hr assessment period.
 2. At week 52, 3 of 17 placebo patients were given mavorixafor in advance of their TAT measurements as they entered the open-label portion of the study. All data are included in ITT analysis.
 3. Data on file.



Phase 3 Clinical Trial

Reduced
RATE
of infections

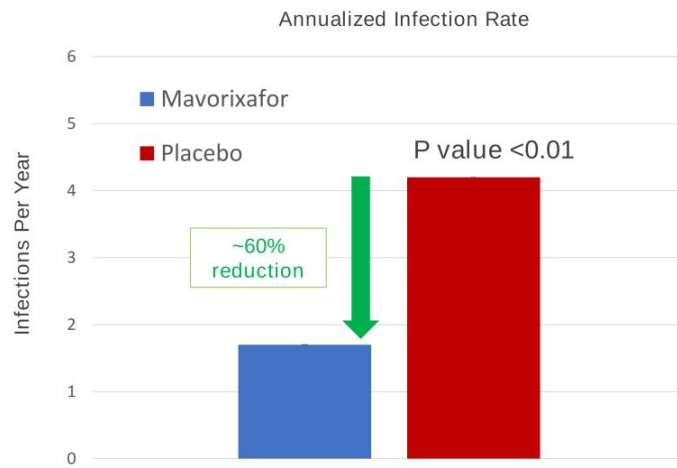
Reduced
SEVERITY
of infections

Reduced
DURATION
of infections

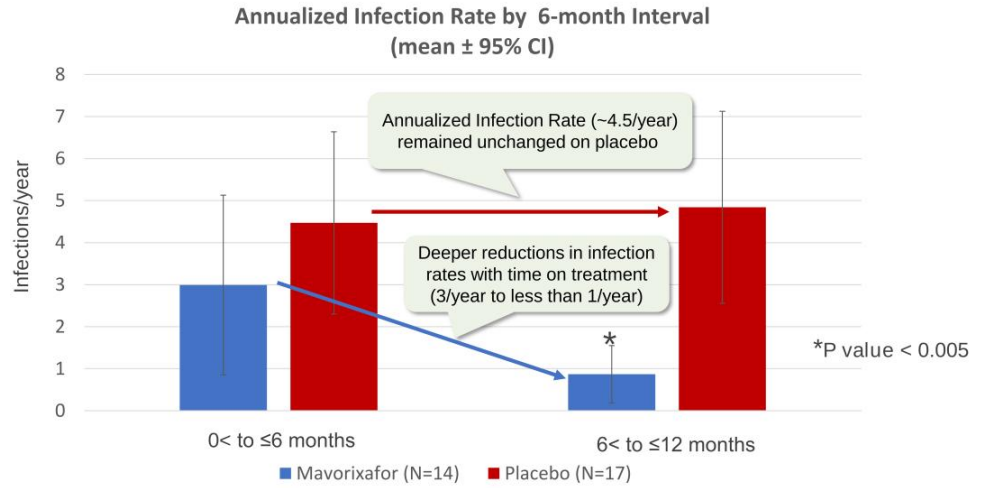
Infections Are The Major Problem in WHIM:
Mavorixafor Delivered Benefit



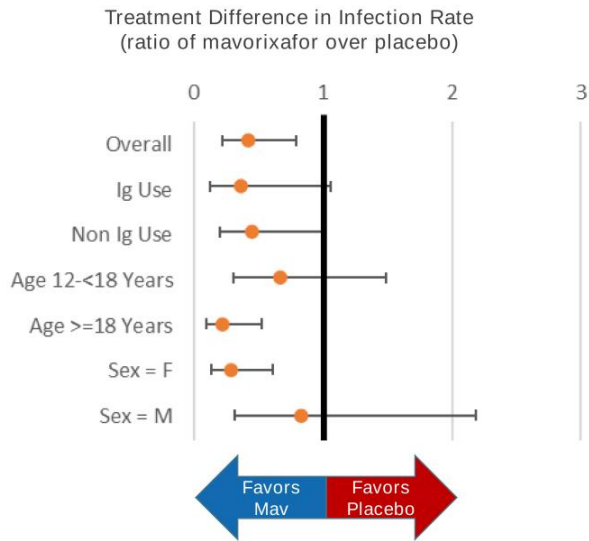
Statistically Significant 58% Reduction in Annualized Infection Rate Mavorixafor versus placebo (ITT population)



Deeper Reductions in Infection Rate with Time on Mavorixafor Treatment First 6-months vs. second 6-months (ITT population)



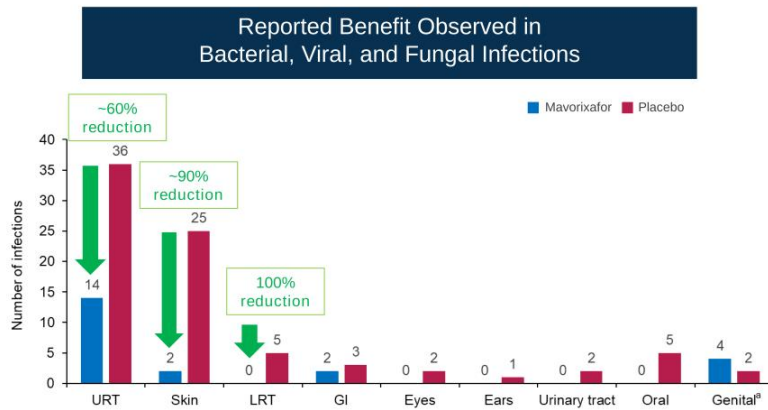
Mavorixafor Reduced Infection Rate Consistently Across Subgroups



All Sub-Groups Had Benefit Favoring Mavorixafor Treatment

- ✓ In those with or without concomitant Ig treatment
- ✓ In both adolescents and adults
- ✓ In both women and men

Mavorixafor Reduced Infections Across Most Organ Systems



URT, upper respiratory tract; GI, gastrointestinal; LRT, lower respiratory tract. *Excluding warts.

Assessment of Warts

First placebo-controlled study assessing warts in WHIM

- ~70% of patients had warts
- Warts assessed at wks 0, 26, and 52
- Photographic images captured
- Visual changes scored via central, blinded committee

Results

- No difference between groups in reducing pre-selected, existing warts
- Fewer participants on mavorixafor developed new warts at week 52



Phase 3 Clinical Trial

Reduced
RATE
of infections

Reduced
SEVERITY
of infections

Reduced
DURATION
of infections

Infections are the Major Problem in WHIM:
Mavorixafor Delivered Benefit



Severity of Infections: Assessed by Standard CTCAE¹ Criteria

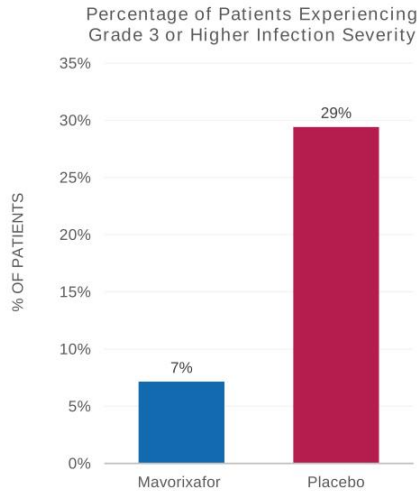
- Severe Infections: Grade 3 or Higher
 - Require significant intervention (oral and/or IV antibiotics) and/or hospitalization
 - Assessed by blinded, centralized, independent, adjudication committee

Severity Scale	Description
Grade 3	Severe or medically significant but not immediately life-threatening; hospitalization or prolongation of hospitalization indicated; disabling; limiting self care activities of daily living (ADL**)
Grade 4	Life-threatening consequences; urgent intervention indicated.
Grade 5	Death

**Self care ADL refer to bathing, dressing and undressing, feeding self, using the toilet, taking medications, and not bedridden



More Patients on Placebo Experienced Severe¹ Infections Over 52 Weeks



	Mavorixafor (n=14)	Placebo (n=17)
CTCAE Criteria	N	N
Grade 1 / Grade 2	10	11
Grade 3	1*	4
Grade 4	0	1
Grade 5	0	0

*Grade 3 infection on mavorixafor treatment occurred during first 3 months of treatment; rate of severe infections on placebo unchanged over 52-week period

Zero Grade 3 infections on mavorixafor after the first three months of treatment



1. Severe infections are those Grade 3 or higher by CTCAE criteria.

Patients on Placebo More Heavily Treated with Anti-bacterials Consistent with higher rate and severity of infections

- 10/17 (59%) on placebo were administered anti-bacterials/penicillins vs. 3/14 (21%) on mavorixafor
 - Amoxicillin or amoxicillin+other combination were most commonly prescribed anti-bacterial treatments

Anti-Bacterial Medications Used in Study	Placebo (n=17)	Mavorixafor (n=14)	Total (n=31)
	N (%)	N (%)	N (%)
Beta-lactam anti-bacterials, penicillins	10 (59)	3 (21)	13 (42)

Mavorixafor-treated participants experienced fewer infections and needed less treatment



Phase 3 Clinical Trial

Reduced
RATE
of infections

Reduced
SEVERITY
of infections

Reduced
DURATION
of infections

Infections are the Major Problem in WHIM:
Mavorixafor Delivered Benefit



Total Time with Infection Reduced by >70% with Mavorixafor vs. Placebo

- Mean total time with infection: ~2 weeks on mavorixafor vs. ~7 weeks on placebo
- Median total time with infection also showed (~75%) reduction

Total Time with Infection
(in days)

	Mavorixafor (n=14)	Placebo (n=17)
Mean (SD)	14.1 (2 weeks)	49.1 (7 weeks)
Median	8.5	32.0
Min, Max	0, 43	8, 134

Oral Mavoxifafor was Well Tolerated in the Trial Top-line safety data summary for randomization period

Overall

- No treatment-related Serious Adverse Events (SAEs)
- No treatment-limiting toxicities
- No discontinuations due to safety events
- ~90% of patients continued into the Open Label Extension study

Other Adverse Events

- Most related to background disease (infections and low platelets)



Safety Assessment: Supports Chronic Dosing for Mavorixafor

- Placebo arm had increased (3x to 4x) infections/infestations and respiratory disorders
- Mavorixafor arm had increased skin & GI disorders
 - No discontinuations - all were mild, all resolved
- Other safety assessments showed balance between two arms and/or deemed non-drug related

System Organ Class	Placebo (n=17)		Mavorixafor (n=14)		Total (n=31)	
	Subjects N (%)	Events	Subjects N (%)	Events	Subjects N (%)	Events
Any TEAE	17 (100)	143	14 (100)	88	31 (100)	231
Infections and infestations	17 (100)	96	11 (79)	28	28 (90)	124
Respiratory, thoracic and mediastinal disorders	6 (35)	9	2 (14)	3	8 (26)	12
Skin disorders	3 (18)	6	8 (57)	11	11 (36)	17
GI disorders	2 (12)	2	5 (36)	6	7 (23)	8

Path Forward: Preparing for our First NDA Regulatory Submission

- ✓ Pre-NDA meeting with FDA completed in early Q2
 - WHIM Phase 3 clinical and other data discussed
- ✓ Overall favorable commentary and guidance

US NDA submission for mavorixafor in the treatment of WHIM syndrome remains on track for early 2H 2023



X4 Eligible for
Priority Review
Voucher (PRV)

Preparation
Underway for
Potential 1H 2024
US Launch in
WHIM Syndrome



1

Building the WHIM Syndrome Community

- Establish X4 as a trusted partner with key stakeholders
- Educate on WHIM syndrome, highlighting unmet need and enabling better patient identification
- Support earlier diagnoses leading to better patient outcomes

2

Ensuring Broad Patient Access

- Communicate the mavorixafor value proposition
- Implement distribution and supply chain
- Engage with Payers to ensure rapid reimbursement

3

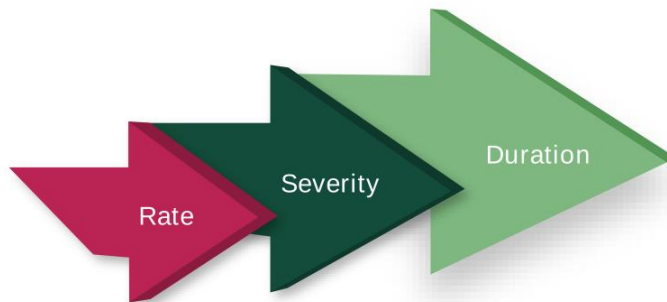
Evolving X4 to a Fully Integrated Biotech

- Build a rare disease commercial organization
- Establish infrastructure and capabilities
- Coordinate cross-functional launch readiness

Leveraging Our Success in WHIM into Chronic Neutropenic Disorders

WHIM Phase 3: Provides Proof of Concept Supporting CN

Increased Absolute Neutrophil Counts (ANC)
and Clinical Benefit in Reducing Infection Burden



Mavorixafor

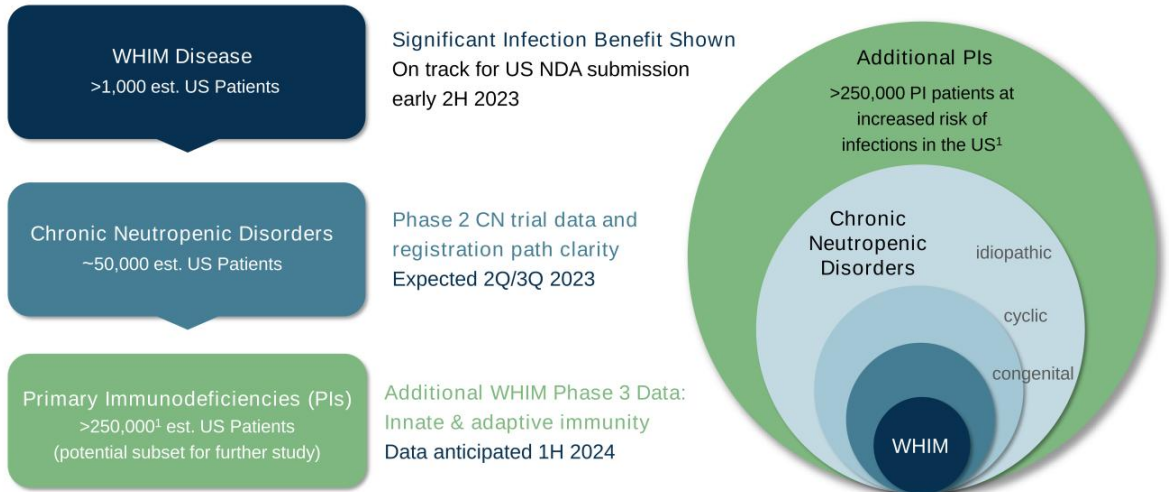
Potential oral, well tolerated,
once-daily option for CN

Exploring use in idiopathic, cyclic, and
congenital chronic neutropenic

Phase 2 Study ongoing

Potential Phase 3 trial in 2024

Maximizing Mavorixa for Potential to Address Infection Risk in CN and Beyond



1. Boyle JM, Buckley RH. Population prevalence of diagnosed primary immunodeficiency diseases in the United States. J Clin Immunol. 2007 Sep;27(5):497-502

Thank You!



