

PROSPECTUS

GENOCEA BIOSCIENCES, INC.
21,390,902 Shares of Common Stock
Warrants to Purchase 45,835,978 Shares of Common Stock

This prospectus relates to the resale or other disposition from time to time of up to (i) 21,390,902 shares of our common stock, par value \$0.001 per share (the "Common Stock"), and (ii) up to 45,835,978 shares of Common Stock upon the exercise of warrants by the selling stockholders identified in this prospectus, including their transferees, pledgees, donees or successors.

The selling stockholders may, from time to time, sell, transfer, or otherwise dispose of any or all of their securities from time to time on any stock exchange, market, or trading facility on which the securities 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. See "Plan of Distribution" which begins on page 11.

We are not offering any shares of our Common Stock for sale under this prospectus. We will not receive any of the proceeds from the sale of common stock by the selling stockholders. However, we will generate proceeds in the event of a cash exercise of the warrants by the selling stockholders. All expenses of registration incurred in connection with this offering are being borne by us. All selling and other expenses incurred by the selling stockholders will be borne by the selling stockholders.

Our common stock is quoted on the Nasdaq Capital Market under the symbol "GNCA." On August 18, 2020, the last reported sale price of our common stock as reported on the Nasdaq Capital Market was \$2.71 per share.

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

Investing in our securities involves risks. See "Risk Factors" on page 3, and any applicable prospectus supplement, and under similar headings in the other documents that are incorporated by reference into this prospectus.

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

Prospectus dated August 28, 2020

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ABOUT THIS PROSPECTUS

This prospectus is part of a registration statement on Form S-3 that we filed with the Securities and Exchange Commission (the “SEC”) using a “shelf” registration or continuous offering process.

You should read this prospectus and the information and documents incorporated by reference carefully. Such documents contain important information you should consider when making your investment decision. See “Where You Can Find More Information” and “Incorporation of Documents by Reference” in this prospectus.

This prospectus may be supplemented from time to time to add, to update or change information in this prospectus. Any statement contained in this prospectus will be deemed to be modified or superseded for purposes of this prospectus to the extent that a statement contained in such prospectus supplement modifies or supersedes such statement. Any statement so modified will be deemed to constitute a part of this prospectus only as so modified, and any statement so superseded will be deemed not to constitute a part of this prospectus. You should rely only on the information contained or incorporated by reference in this prospectus, any applicable prospectus supplement or any related free writing prospectus. We have not authorized any other person to provide you with different information. If anyone provides you with different or inconsistent information, you should not rely on it. No dealer, salesperson or other person is authorized to give any information or to represent anything not contained in this prospectus, any applicable prospectus supplement or any related free writing prospectus. This prospectus is not an offer to sell securities, and it is not soliciting an offer to buy securities, in any jurisdiction where the offer or sale is not permitted. You should assume that the information appearing in this prospectus or any prospectus supplement, as well as information we have filed with the SEC that is incorporated by reference, is accurate as of the date on the front of those documents only, regardless of the time of delivery of this prospectus or any applicable prospectus supplement, or any sale of a security. Our business, financial condition, results of operations and prospects may have changed since those dates.

This prospectus contains summaries of certain provisions contained in some of the documents described herein, but reference is made to the actual documents for complete information. All of the summaries are qualified in their entirety by the actual documents. Copies of some of the documents referred to herein have been filed, will be filed or will be incorporated by reference as exhibits to the registration statement of which this prospectus is a part, and you may obtain copies of those documents as described below under “Where You Can Find More Information.”

Unless otherwise stated or the context requires otherwise, references in this prospectus to “Genocea,” the “company” or the “Company,” “we,” “us,” or “our” refer to Genocea Biosciences, Inc. and its consolidated subsidiary unless stated or the context otherwise requires.

ABOUT THE COMPANY

Company Overview

We are a biopharmaceutical company that seeks to discover and develop novel cancer immunotherapies using our ATLAS proprietary discovery platform. The ATLAS platform profiles each patient's CD4⁺ and CD8⁺ T cell immune responses to every potential target or "antigen" in that patient's tumor. We believe that this approach optimizes antigen selection for immunotherapies such as cancer vaccines and cellular therapies. Consequently, we believe that ATLAS could lead to more immunogenic and efficacious cancer immunotherapies.

Our most advanced program is GEN-009, a personalized neoantigen cancer vaccine, for which it is conducting a Phase 1/2a clinical trial. The GEN-009 program uses ATLAS to identify neoantigens, or immunogenic tumor mutations unique to each patient, for inclusion in each patient's GEN-009 vaccine. We are also advancing GEN-011, a neoantigen-specific adoptive T cell therapy program that also relies on ATLAS. In June 2020, we submitted an Investigational New Drug (IND) application to support the initiation of a Phase 1/2 clinical trial. We have received notification from the U.S. Food and Drug Administration (FDA) that the agency has completed its review of our IND application for GEN-011. The FDA informed us that it is placing the IND on clinical hold until it receives additional information pertaining to certain third-party reagents used in the GEN-011 manufacturing process. These reagents are not a component of the final cell therapy product. We intend to work with the FDA to resolve their questions as quickly as possible.

Our principal executive offices are located at 100 Acorn Park Drive, Cambridge, MA 02140, and our telephone number is (617) 876-8191. Our website address is: www.genocoea.com. We have included our website address as a factual reference and do not intend it to be an active link to our website. The information that can be accessed through our website is not part of this prospectus, and investors should not rely on any such information in deciding whether to purchase our common stock.

RISK FACTORS

An investment in our common stock involves risks. Prior to making a decision about investing in our common stock, you should consider carefully the risks together with all of the other information contained or incorporated by reference in this prospectus, including any risks described in the section entitled "Risk Factors" contained in any supplements to this prospectus, in our Annual Report on Form 10-K for the year ended December 31, 2019, in our Quarterly Report on Form 10-Q for the quarter ended March 31, 2020 and in our subsequent filings with the SEC. Each of the referenced risks and uncertainties could adversely affect our business, prospects, operating results and financial condition, as well as adversely affect the value of an investment in our securities. Additional risks not known to us or that we believe are immaterial may also adversely affect our business, operating results and financial condition and the value of an investment in our securities.

DESCRIPTION OF PRIVATE PLACEMENT OF COMMON STOCK AND WARRANTS

On July 24, 2020, we completed a private placement financing transaction (the “Closing”) pursuant to a Securities Purchase Agreement (the “Purchase Agreement”), in which we issued (i) 21,390,902 shares (the “Shares”) of Common Stock, (ii) pre-funded warrants (the “Pre-Funded Warrants”) to purchase 12,222,538 shares of Common Stock (the “Pre-Funded Warrant Shares”), and (iii) warrants (the “Closing Warrants”) to purchase up to 33,613,440 shares of Common Stock (the “Warrant Shares”). The Shares, Pre-Funded Warrants and Closing Warrants (collectively, the “Securities”) were sold at a purchase price of \$2.38 per unit for aggregate gross cash proceeds of approximately \$80 million, excluding transactions costs, fees and expenses. The purchasers of the Shares, Pre-Funded Warrants and Closing Warrants were the selling stockholders named in this prospectus (the “Purchasers”).

Warrants and Pre-Funded Warrants

The material terms and provisions of the Closing Warrants and the Pre-Funded Warrants to purchase shares of Common Stock are summarized below. This summary is subject to and qualified in its entirety by the form of warrant and pre-funded warrant, which were filed with the SEC as exhibits to the Company’s Form 8-K on July 22, 2020.

Exercisability. The holder may exercise the Closing Warrants at any time or from time to time through July 24, 2024. The holder may exercise the Pre-Funded Warrants at any time. There is no expiration date for the Pre-Funded Warrants. As further described under “Selling Stockholders,” notwithstanding the foregoing, certain holders will be prohibited from exercising such warrants into shares of our common stock if, as a result of such exercise, the holder, together with its affiliates, would own more than a specific percentage of the total number of shares of our common stock then issued and outstanding. The Closing Warrants and Pre-Funded Warrants are exercisable, at the option of each holder, in whole or in part, by delivering to us a duly executed exercise notice accompanied by payment in full for the number of shares of our common stock purchased upon such exercise (except in the case of a cashless exercise as discussed below).

Exercise Price. The exercise price upon exercise of each Closing Warrant is \$2.25 per share of Common Stock and the exercise price of each Pre-Funded Warrant is \$2.25 per share of Common Stock, of which \$2.24 per share was paid by each purchaser of Pre-Funded Warrants at the Closing. The exercise price of the warrants is subject to appropriate adjustment in the event of stock dividends, subdivisions, stock splits, stock combinations, reclassifications or reorganizations affecting our common stock.

Payment of Exercise Price. The warrant holders have the option to provide payment of the exercise price of the shares being acquired upon exercise of the warrants (i) by wire transfer or cashier’s check, or, in certain circumstances as described below (ii) by cashless exercise.

Cashless Exercise. If at any time there is no effective resale registration statement registering the resale of the Closing Warrants or Pre-Funded Warrants, in lieu of making the cash payment otherwise contemplated to be made to us upon such exercise in payment of the aggregate exercise price, the holder may elect instead to receive upon such exercise the net number of shares of common stock determined according to a formula set forth in the Closing Warrants or Pre-Funded Warrants.

Transferability. Subject to applicable laws and the restriction on transfer set forth in the warrant agreement, the warrants may be transferred at the option of the holders upon surrender of the warrants to the warrant agent together with the appropriate instruments of transfer.

Change of Control Transactions. If, at any time while each Closing Warrant or Pre-Funded Warrant is outstanding, there is a Change of Control, which generally includes a merger or consolidation resulting in the sale of 50% or more of the voting securities of the Company, the sale of all or substantially all of the assets or voting securities of the Company, or other change of control transaction, then the holder has the right thereafter to receive, upon exercise of the Closing Warrant or Pre-Funded Warrant, the same amount and kind of securities, cash or property as it would have been entitled to receive upon the occurrence of such Change of Control if it had been, immediately prior to such Change of Control, the holder of the number of Warrant Shares then issuable upon exercise in full of the Closing Warrant or Pre-Funded Warrant (the “Alternate Consideration”). If holders of Common Stock are given any choice as to the securities, cash or property to be received in a Change of Control, then the holder will be given the same choice as to the Alternate Consideration it receives upon any exercise of the Closing Warrants or Pre-Funded Warrants following such Change of Control.

Events of Failure. In the event that we fail to timely deliver shares of Common Stock to any holder, we are required to make whole any holder who purchases shares of Common Stock to deliver in satisfaction of a sale by such holder of shares of Common Stock issuable upon an exercise of the Closing Warrants or the Pre-Funded Warrants that the holder anticipated

receiving from the Company, as described in the Closing Warrants and Pre-Funded Warrants.

Rights as a Stockholder. Except for the right to participate in certain dividends and distributions and as otherwise provided in the Closing Warrants and the Pre-Funded Warrants or by virtue of a holder's ownership of our common stock, the holders of the Closing Warrants and Pre-Funded Warrants do not have the rights or privileges of holders of our Common Stock, including any voting rights, until they exercise their warrants.

Waivers and Amendments. Any term of the Closing Warrants and Pre-Funded Warrants may be amended or waived with our written consent and the written consent of the holder of such Closing Warrant or Pre-Funded Warrant.

No Fractional Shares. No fractional shares or scrip representing fractional shares shall be issued upon the exercise of the Closing Warrants or Pre-Funded Warrants. As to any fraction of a share which the holder would otherwise be entitled to purchase upon such exercise, we shall cause the warrant agent to, at our option, pay a cash adjustment in respect of such final fraction in an amount equal to such fraction multiplied by the exercise price of the Closing Warrant or Pre-Funded Warrant per whole share or round such fractional share up to the nearest whole share.

DISCLOSURE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus, any prospectus supplement and the other documents we have filed with the SEC that are incorporated herein by reference, contain forward-looking statements that involve substantial risks and uncertainties. All statements, other than statements of historical facts, including statements regarding our strategy, future operations, future financial position, future revenues, projected costs, prospects, plans and objectives of management, are forward-looking statements. The words “anticipate,” “believe,” “estimate,” “expect,” “intend,” “may,” “plan,” “predict,” “project,” “target,” “potential,” “will,” “would,” “could,” “should,” “continue,” and similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words. We may not actually achieve the plans, intentions or expectations disclosed in our forward-looking statements, and you should not place undue reliance on our forward-looking statements. Actual results or events could differ materially from the plans, intentions and expectations disclosed in the forward-looking statements we make. In particular, you should consider the numerous risks described in our Annual Report on Form 10-K for the year ended December 31, 2019 and any subsequent Quarterly Reports on Form 10-Q, each incorporated by reference in this prospectus, and in the “Risk Factors” section in any applicable prospectus supplement. See “Where You Can Find More Information.”

Although we believe the expectations reflected in the forward-looking statements are reasonable, we cannot guarantee future results, level of activity, performance or achievements. You should not rely upon forward-looking statements as predictions of future events. Unless required by law, we will not undertake and we specifically disclaim any obligation to release publicly the result of any revisions which may be made to any forward-looking statements to reflect events or circumstances after the date of such statements or to reflect the occurrence of events, whether or not anticipated. In that respect, we wish to caution readers not to place undue reliance on any such forward-looking statements, which speak only as of the date they are made.

This prospectus and the other documents incorporated by reference herein include statistical and other industry and market data that we obtained from industry publications and research, surveys and studies conducted by third parties. Industry publications and third party research, surveys and studies generally indicate that their information has been obtained from sources believed to be reliable, although they do not guarantee the accuracy or completeness of such information. While we believe these industry publications and third party research, surveys and studies are reliable, we have not independently verified such data.

These risks and uncertainties include, among other things:

- our estimates regarding the timing and amount of funds we require to conduct clinical trials for GEN-009 and GEN-011, to continue preclinical studies for our other product candidates and to continue our investments in immuno-oncology;
- our estimates regarding expenses, future revenues, capital requirements, the sufficiency of our current and expected cash resources and our need for additional financing;
- the timing of, and our ability to, obtain and maintain regulatory approvals for our product candidates;
- the effect of the novel coronavirus (COVID-19) pandemic on the economy generally and on our business and operations specifically, including our research and development efforts, our clinical trials and our employees, and the potential disruptions in supply chains and to our third party manufacturers, including the availability of materials and equipment;
- the potential benefits of strategic partnership agreements and our ability to enter into strategic partnership arrangements;
- our intellectual property position;
- the rate and degree of market acceptance and clinical utility of any approved product candidate;
- our ability to quickly and efficiently identify and develop product candidates; and
- our commercialization, marketing and manufacturing capabilities and strategies.

USE OF PROCEEDS

The selling stockholders will receive all of the net proceeds from sales of the Common Stock pursuant to this prospectus. However, in the case of Closing Warrants and Pre-Funded Warrants issued to the selling stockholders pursuant to the Purchase Agreement, upon any exercise of the Closing Warrants and Pre-Funded Warrants for cash, the selling stockholders would pay us an exercise price of \$2.25 and \$0.01 per share of Common Stock, respectively, subject to any adjustment pursuant to the terms of the Closing Warrants and Pre-Funded Warrants. We expect to use any such proceeds to fund continued clinical and program development of our neoantigen vaccine GEN-009 and our neoantigen cell therapy GEN-011, as well as for working capital and other general corporate purposes.

SELLING STOCKHOLDERS

Pursuant to the Purchase Agreement, we agreed to file the registration statement of which this prospectus is a part to cover the resale of the shares of our Common Stock and the shares underlying the Closing Warrants and Pre-Funded Warrants, and to keep such registration statement effective with respect to each selling stockholder until the date on which all of the shares of our Common Stock registered for resale under the registration statement have been disposed of in accordance with such registration statement, disposed of pursuant to Rule 144 under the Securities Act, or can be resold pursuant to Rule 144 without restriction or limitation (including without any limitation as to volume of sales and without the selling stockholder complying with any method of sale requirements or notice requirements under Rule 144). The shares issuable upon exercise of the Closing Warrants and Pre-Funded Warrants will become eligible for sale by the selling stockholders under this prospectus only when the Closing Warrants or Pre-Funded Warrants are exercised. We cannot predict when or whether any of the selling stockholders will exercise their Closing Warrants or Pre-Funded Warrants.

We are registering the resale of the above-referenced shares to permit each of the selling stockholders identified below, or their permitted transferees or other successors-in-interest that may be identified in a supplement to this prospectus or, if required, a post-effective amendment to the registration statement of which this prospectus is a part, to resell or otherwise dispose of the shares in the manner contemplated under “Plan of Distribution” in this prospectus (as may be supplemented and amended). This prospectus covers the sale or other disposition by the selling stockholders of up to the total number of shares of Common Stock that may be issued to the selling stockholders pursuant to the Purchase Agreement, plus the total number of shares of Common Stock issuable upon exercise of the Closing Warrants and Pre-Funded Warrants issued to the selling stockholders. Throughout this prospectus, when we refer to the shares of our Common Stock being registered on behalf of the selling stockholders, we are referring to the shares of our Common Stock and the shares underlying the Closing Warrants and Pre-Funded Warrants issued to the selling stockholders pursuant to the Purchase Agreement, and when we refer to the selling stockholders in this prospectus, we are referring to the purchasers under the Purchase Agreement and, as applicable, their permitted transferees or other successors-in-interest that may be identified in a supplement to this prospectus or, if required, a post-effective amendment to the registration statement of which this prospectus is a part.

The selling stockholders may sell some, all or none of their shares. We do not know how long the selling stockholders will hold the shares before selling them, and we currently have no agreements, arrangements or understandings with the selling stockholders regarding the sale or other disposition of any of the shares. The shares of our Common Stock covered hereby may be offered from time to time by the selling stockholders.

When we refer to “selling shareholders” in this prospectus, we mean those persons listed in the table below, as well as their transferees, pledgees or donees or their successors. The information regarding shares beneficially owned after the offering assumes the sale of all shares offered by the selling shareholders. To our knowledge, subject to community property laws where applicable, each person named in the table has sole voting and investment power with respect to the shares of Common Stock set forth opposite such person’s name.

The following table sets forth the name of each selling stockholder, the number and percentage of our Common Stock beneficially owned by the selling stockholders as of July 31, 2020, the number of shares of our Common Stock that may be offered under this prospectus, and the number and percentage of our Common Stock beneficially owned by the selling stockholders assuming all of the shares of our Common Stock registered hereunder are sold. Beneficial ownership is determined in accordance with the rules of the SEC and includes voting or investment power with respect to our Common Stock. Generally, a person “beneficially owns” shares of our Common Stock if the person has or shares with others the right to vote those shares or to dispose of them, or if the person has the right to acquire voting or disposition rights within 60 days. The number of shares of our Common Stock in the column “Number of Shares Offered” represents all of the shares of our Common Stock that a selling stockholder may offer and sell from time to time under this prospectus. For certain selling stockholders, the number of shares of Common Stock into which the Closing Warrants and Pre-Funded Warrants beneficially held by such selling stockholder are exercisable are limited pursuant to the terms of the Closings Warrants and Pre-Funded Warrants to a number of shares of Common Stock which would result in such selling stockholder having aggregate individual beneficial ownership of the total issued and outstanding shares of Common Stock over specified percentage thresholds (collectively, referred to as the “Beneficial Ownership Limitation”).

Name and Address	Prior to Offering		Number of Shares Offered	After Offering	
	Number of Shares Beneficially Owned	Percentage of Shares Beneficially Owned		Number of Shares Beneficially Owned	Percentage of Shares Beneficially Owned
New Enterprise Associates 16, L.P. 1954 Greenspring Drive, Suite 600 Timonium, MD 21093	15,401,579 (1)	27.22 %	6,302,520	9,099,059	16.63 %
Avoro Life Sciences Fund LLC 110 Greene Street, Suite 800 New York, NY 10012	5,158,217 (2)	9.99 %	33,613,444	—	-%
S.R. One, Limited 161 Washington Street, Suite 500 Conshohocken, PA 19428	5,209,027 (3)	9.99 %	2,521,008	3,676,768	6.96 %
Entities affiliated with BVF Partners L.P. 44 Montgomery Street, 40 th Floor San Francisco, CA 94104	5,204,225 (4)	9.99 %	6,302,520	3,365,566	6.10 %
Citadel Multi-Strategy Equities Master Fund Ltd. 601 Lexington Avenue New York, NY 10022	3,361,344 (5)	6.31 %	3,361,344	—	-%
M. Kingdon Offshore Master Fund L.P. 152 West 57 th Street, 50 th Floor New York, NY 10019	2,604,386 (6)	4.99 %	2,521,008	711,552	1.35 %
Entities affiliated with EcoR1 Capital, LLC 357 Tehama Street, #3 San Francisco, CA 94103	2,597,622 (7)	4.99 %	4,201,680	—	-%
Entities affiliated with Pontifax 14 Shenkar Street, Herzliya, Israel	2,597,622 (8)	4.99 %	4,201,678	—	-%
Entities affiliated with Boxer Capital, LLC 11682 El Camino Real, Suite 320 San Diego, CA 92130	2,521,006 (9)	4.77 %	2,521,006	—	-%
Lincoln Park Capital Fund, LLC 440 N. Wells Street, Suite 410 Chicago, IL 60654	1,793,172 (10)	3.42 %	1,680,672	112,500	*%

*Represents less than 1%.

(1) Based on a Schedule 13D filed with the SEC on August 3, 2020, consists of 10,376,936 shares of Common Stock, a Class C warrant to purchase, subject to certain limitations, up to an aggregate of 3,151,260 shares of Common Stock, a Class A warrant to purchase, subject to certain limitations, up to an aggregate of 1,562,500 shares of Common Stock, and a Class B warrant to purchase, subject to certain limitations, up to an aggregate of 310,883 shares of Common Stock, held by New Enterprise Associates 16, L.P. (NEA 16). NEA Partners 16, L.P. (NEA Partners 16), is the sole general partner of NEA 16. NEA 16 GP, LLC (NEA 16 LLC), is the sole general partner of NEA Partners 16. Forest Baskett, Ali Behbahani, Carmen Chang, Anthony Florence, Jr., Mohamad Makhzoumi, Joshua Makower, Scott D. Sandell, Paul Walker, and Peter Sonsini, are the managers of NEA 16 LLC. NEA Partners 16, NEA 16 LLC and the managers of NEA 16 LLC share voting and dispositive power with regard to the securities held by NEA 16. Each of NEA Partners 16 and NEA 16 LLC as well as each of the managers of NEA 16 LLC disclaims beneficial ownership of all shares held by NEA 16 except to the extent of their actual pecuniary interest therein.

(2) Consists of 5,084,184 shares of common stock and 74,033 shares of common stock issuable upon the exercise of warrants held by Avoro Life Sciences Fund LLC (“Avoro Life Sciences”). Excludes 28,455,227 shares of common stock issuable upon the exercise of warrants, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock into which the warrants are convertible is limited to that number of shares of common stock which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 9.99% of the total issued and outstanding shares of common stock. Avoro Capital Advisors LLC (“Avoro Capital”) is the investment advisor for Avoro Life Sciences, and Behzad Aghazadeh serves as the portfolio manager and controlling person of Avoro Capital.

(3) Consists of 4,626,389 shares of common stock and 582,638 shares of common stock issuable upon the exercise of warrants. Excludes 988,749 shares of common stock issuable upon the exercise of warrants, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock into which the warrants are convertible is limited to that number of shares of common stock

which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 9.99% of the total issued and outstanding shares of common stock. These shares and warrants are held directly by S.R. One, Limited, an indirect wholly-owned subsidiary of GlaxoSmithKline plc.

(4) Consists of 2,432,842 shares of common stock held of record by Biotechnology Value Fund, L.P. (“BVF”), 1,820,285 shares of common stock held of record by Biotechnology Value Fund II, L.P. (“BVF2”), 317,042 shares of common stock held of record by Biotechnology Value Trading Fund OS LP (“Trading Fund OS”), and 99,489 shares of common stock held of record by MSI BVF SPV L.L.C. Also includes 534,567 shares of common stock issuable upon exercise of warrants held by the above referenced BVF entities. Excludes 4,463,861 shares of common stock issuable upon the exercise of warrants, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock into which the warrants are convertible is limited to that number of shares of common stock which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 9.99% of the total issued and outstanding shares of common stock.

(5) Consists of 1,680,672 shares of common stock and 1,680,672 shares of common stock issuable upon the exercise of warrants to Citadel Multi-Strategy Equities Master Fund Ltd. (“Citadel”). Citadel Advisors LLC (“Citadel Advisors”) acts as the portfolio manager of Citadel. Citadel Advisors Holdings LP (“CAH”) is the sole member of Citadel Advisors. Citadel GP LLC (“CGP”) is the general partner of CAH. Mr. Kenneth Griffin is the President and Chief Executive Officer of CGP and owns a controlling interest in CGP and may be deemed to share voting and dispositive power over the shares held by Citadel. The address for Citadel is c/o Citadel Advisors LLC, 601 Lexington Avenue, New York, NY 10022.

(6) Consists of 1,972,056 shares of common stock and 632,330 shares of common stock issuable upon the exercise of warrants to M. Kingdon Offshore Master Fund L.P. Excludes 628,174 shares of common stock issuable upon the exercise of warrants, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock into which the warrants are convertible is limited to that number of shares of common stock which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 4.99% of the total issued and outstanding shares of common stock. Mark Kingdon is the Managing Member of Kingdon GP, LLC, which is the general partner of M. Kingdon Offshore Master Fund L.P.

(7) Consists of 2,100,840 shares of common stock and 496,782 shares of common stock issuable upon the exercise of warrants, collectively held by to EcoR1 Capital Fund Qualified, LP and EcoR1 Capital Fund, LP, (“the EcoR1 Funds”). For the above referenced entities, this excludes 1,604,058 shares of common stock issuable upon the exercise of warrants, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock for which the warrants are convertible is limited to that number of shares of common stock which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 4.99% of the total issued and outstanding shares of common stock. The EcoR1 Funds are managed by EcoR1 Capital, LLC., which is managed by Oleg Nodelman.

(8) Consists of 2,100,839 shares of common stock and 496,783 shares of common stock issuable upon the exercise of warrants collectively held by Pontifax (Israel) V L.P, Pontifax (China) V L.P., Pontifax (Cayman) V L.P. and Pontifax Late Stage Fund L.P. Excludes 1,604,056 shares of common stock issuable upon the exercise of warrants to the above referenced entities, which are not exercisable within 60 days of July 31, 2020 by virtue of the beneficial ownership limitation described below. The number of shares of common stock into which the warrants are convertible is limited to that number of shares of common stock which would result in the stockholders, together with its affiliates, having an aggregate beneficial ownership of no more than 4.99% of the total issued and outstanding shares of common stock.

(9) Consists of 1,134,453 shares of common stock and 1,134,453 shares of common stock issuable upon the exercise of warrants to Boxer Capital, LLC, and 126,050 shares of common stock and 126,050 shares of common stock issuable upon the exercise of warrants to MVA Investors, LLC. Boxer Asset Management Inc. is the managing member and majority owner of Boxer Capital, LLC. Joseph Lewis is the sole indirect owner and controls Boxer Asset Management Inc. MVA Investors, LLC is the independent, personal investment vehicle of certain employees of Boxer Capital, LLC. MVA Investors, LLC is the independent, personal investment vehicle of certain employees of Boxer Capital, LLC.

(10) Consists of 890,336 shares of common stock and 902,836 shares of common stock issuable upon the exercise of warrants. Josh Scheinfeld and Jonathan Cope, as principals of Lincoln Park Capital Fund, LLC, are deemed to be

beneficial owners of all shares of common stock owned by Lincoln Park Capital Fund, LLC. Messrs. Schienfeld and Cope have shared voting and dispositive power over such shares.

PLAN OF DISTRIBUTION

The selling stockholders, which as used herein includes donees, pledgees, transferees or other successors-in-interest selling shares of Common Stock previously issued and the shares of Common Stock issuable upon exercise of the Closing Warrants or Pre-Funded Warrants or interests in shares of Common Stock received after the date of this prospectus from a selling stockholder as a gift, pledge, partnership distribution or other transfer, may, from time to time, sell, transfer or otherwise dispose of any or all of their shares of Common Stock or interests in shares of Common Stock on any stock exchange, market or trading facility on which the shares are traded or in private transactions. The selling stockholders may sell their shares of our Common Stock pursuant to this prospectus 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.

If the selling stockholders effect such transactions by selling shares of Common Stock to or through underwriters, broker-dealers or agents, such underwriters, broker-dealers or agents may receive commissions in the form of discounts, concessions or commissions from the selling stockholders or commissions from purchasers of the shares of Common Stock for whom they may act as agent or to whom they may sell as principal (which discounts, concessions or commissions as to particular underwriters, broker-dealers or agents may be in excess of those customary in the types of transactions involved).

Broker-dealers engaged by the selling stockholders may arrange for other brokers-dealers to participate in sales. Broker-dealers may receive commissions or discounts from the selling stockholders (or, if any broker-dealer acts as agent for the purchaser of securities, from the purchaser) in amounts to be negotiated.

The selling stockholders may, from time to time, pledge or grant a security interest in some or all of the shares of Common Stock owned by them and, if they default in the performance of their secured obligations, the pledgees or secured parties may offer and sell the shares of Common Stock, from time to time, under this prospectus, or under an amendment to this prospectus under Rule 424(b)(3) or other applicable provision of the Securities Act amending the list of selling stockholders to include the pledgee, transferee or other successors in interest as selling stockholders under this prospectus. The selling stockholders also may transfer the shares of Common Stock in other circumstances, in which case the transferees, pledgees 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 our 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 our 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 them will be the purchase price of the Common Stock less discounts or commissions, if any. Each of the selling stockholders reserves the right to accept and, together with their agents from time to time, to reject, in whole or in part, any proposed purchase of Common Stock to be made directly or through agents. We will not receive any of the proceeds from this offering. Upon any exercise of the Closing Warrants or the Pre-Funded Warrants by payment of cash, however, we will receive the exercise price of the Closing Warrants or Pre-Funded Warrants.

The selling stockholders also may resell all or a portion of the shares of Common Stock in open market transactions in reliance upon Rule 144 under the Securities Act, provided that they meet the criteria and conform to the requirements of that rule. In addition, the selling stockholders may transfer the shares of Common Stock by other means not described in this prospectus.

The selling stockholders and any underwriters, broker-dealers or agents that participate in the sale of the Common Stock or interests therein may be “underwriters” within the meaning of Section 2(11) of the Securities Act. Any discounts, commissions, concessions or profit they earn on any resale of the shares may be underwriting discounts and commissions under the Securities Act. Selling stockholders who are “underwriters” within the meaning of Section 2(11) of the Securities Act will be subject to the prospectus delivery requirements of the Securities Act.

To the extent required, the shares of our Common Stock to be sold, the names of the selling stockholders, the respective purchase prices and public offering prices, the names of any agents, dealer or underwriter, 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 Exchange Act may apply to sales of shares in the market and to the activities of the selling stockholders and their affiliates. In addition, to the extent applicable we will make copies of this prospectus (as it may be supplemented or amended from time to time) available to the selling stockholders for the purpose of satisfying the prospectus delivery requirements of the Securities Act. The selling stockholders may indemnify any broker-dealer that participates in transactions involving the sale of the shares against certain liabilities, including liabilities arising under the Securities Act.

Once sold under the registration statement of which this prospectus forms a part, the shares of Common Stock will be freely tradable in the hands of persons other than our affiliates.

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 will pay all expenses of the registration of the shares of Common Stock, including, without limitation, SEC filing fees. We have agreed with the selling stockholders to keep the registration statement of which this prospectus constitutes a part effective until such time as the shares offered by the selling stockholders have been effectively registered under the Securities Act and disposed of in accordance with such registration statement, the shares offered by the selling stockholders have been disposed of pursuant to Rule 144 under the Securities Act or the shares offered by the selling stockholders may be resold pursuant to Rule 144 without restriction or limitation (including without any limitation as to volume of sales and without the selling stockholder complying with any method of sale requirements or notice requirements under Rule 144).

LEGAL MATTERS

The validity of the issuance of the securities offered hereby will be passed upon for us by Ropes & Gray LLP, Boston, Massachusetts.

EXPERTS

The consolidated financial statements of Genocea Biosciences, Inc. appearing in Genocea Biosciences, Inc.'s Annual Report (Form 10-K) for the year ended December 31, 2019, have been audited by Ernst & Young LLP, independent registered public accounting firm, as set forth in their report thereon, (which contains an explanatory paragraph describing conditions that raise substantial doubt about the Company's ability to continue as a going concern as described in Note 1 to the consolidated financial statements), included therein, and incorporated herein by reference. Such financial statements are incorporated herein by reference in reliance upon such report given on the authority of such firm as experts in accounting and auditing.

WHERE YOU CAN FIND MORE INFORMATION

This prospectus is part of a registration statement we filed with the SEC. This prospectus does not contain all of the information set forth in the registration statement and the exhibits to the registration statement. For further information with respect to us and the Common Stock we are offering under this prospectus, we refer you to the registration statement and the exhibits and schedules filed as a part of the registration statement. Neither we nor any agent, underwriter or dealer has authorized any person to provide you with different information. We are not making an offer of Common Stock in any state where the offer is not permitted. You should not assume that the information in this prospectus is accurate as of any date other than the date on the front page of this prospectus, regardless of the time of delivery of this prospectus or any sale of Common Stock offered by this prospectus.

We file annual, quarterly and current reports, proxy statements and other information with the SEC. The SEC maintains a website that contains reports, proxy statements and other information regarding issuers that file electronically with the SEC, including us. The address of the SEC website is www.sec.gov.

We maintain a website at www.genocea.com. Information contained in, or accessible through, our website is not a part of, and is not incorporated into, this prospectus, and you should not consider it part of this prospectus.

INCORPORATION OF DOCUMENTS BY REFERENCE

The SEC allows us to "incorporate by reference" into this prospectus the information we file with it, which means that we can disclose important information to you by referring you to those documents. The information incorporated by reference is considered to be part of this prospectus, and information in documents that we file later with the SEC will automatically update and supersede information in this prospectus. We incorporate by reference into this prospectus the documents listed below and any future filings made by us with the SEC under Section 13(a), 13(c), 14 or 15(d) of the Exchange Act, except for information "furnished" under Items 2.02, 7.01 or 9.01 on Form 8-K or other information "furnished" to the SEC which is not deemed filed and not incorporated in this prospectus, until the termination of the offering of securities described in the applicable prospectus supplement. We hereby incorporate by reference the following documents:

- our Annual Report on Form 10-K for the year ended December 31, 2019, as filed with the SEC on February 13, 2020;
- the information specifically incorporated by reference into our Annual Report on Form 10-K for the year ended December 31, 2019 from our definitive proxy statement on Schedule 14A, as filed with the SEC on April 20, 2020;
- our Current Reports on Form 8-K filed with the SEC on May 22, 2020, June 2, 2020, June 19, 2020 and July 22, 2020; and
- description of our Common Stock contained in our Registration Statement on Form 8-A, as filed with the SEC on January 30, 2014, as supplemented by the description of our common stock contained in Exhibit 4.8 in our Annual Report on Form 10-K for the year ended December 31, 2019, as filed with the SEC on February 13, 2020, including any amendment or report filed for the purpose of updating such description.

Any statement contained in a document incorporated or deemed to be incorporated by reference in this prospectus will be deemed modified, superseded or replaced for purposes of this prospectus to the extent that a statement contained in this prospectus modifies, supersedes or replaces such statement.

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

Investor Relations
100 Acorn Park Drive, 5th Floor
Cambridge, Massachusetts 02140
(617) 876-8191
email address: ir@genoccea.com

Copies of these filings are also available, without charge, on the SEC's website at www.sec.gov and on our website at www.genoccea.com as soon as reasonably practicable after they are filed electronically with the SEC. The information contained on our website is not a part of this prospectus.