

PROSPECTUS SUPPLEMENT
(To Prospectus dated December 22, 2023)



SeaStar Medical Holding Corporation

Up to \$1,901,000 of Common Stock

We previously entered into an at the market offering agreement (the “Offering Agreement”) with H.C. Wainwright & Co., LLC (“Wainwright”) pursuant to which we may offer and sell shares of our common stock from time to time through Wainwright, acting as sales agent, under our prospectus supplement, dated October 14, 2025, and accompanying base prospectus (collectively, the “Prospectus”), having an aggregate offering price of up to \$2,279,989. As of November 6, 2025, we have sold \$1,170,258 of our common stock pursuant to the Offering Agreement, which leaves \$1,109,731 of common stock available under the Prospectus. This prospectus supplement should be read in conjunction with the Prospectus, and is qualified by reference thereto, except to the extent that the information herein amends or supersedes the information contained in the Prospectus. This prospectus supplement is not complete without, and may only be delivered or utilized in connection with, the Prospectus, and any future amendments or supplements thereto.

We are filing this prospectus supplement to amend the Prospectus to increase the maximum amount of shares of our common stock that we are eligible to sell under the Offering Agreement pursuant to the Prospectus under General Instruction I.B.6. of Form S-3. As a result of these limitations, we may currently offer and sell shares of our common stock having an aggregate offering price of up to \$1,901,390. Pursuant to this prospectus supplement, we are registering the offer and sale of up to \$1,901,000 of shares of our common stock. In the event that our public float increases above \$75.0 million, we will no longer be subject to the limitations of General Instruction I.B.6 of Form S-3.

The aggregate market value of our outstanding common stock held by non-affiliates is \$44,394,521, based on 35,802,033 shares of outstanding common stock held by non-affiliates as of November 17, 2025 and a price per share of \$1.24, the closing price of our common stock on September 24, 2025. Pursuant to General Instruction I.B.6 of Form S-3, in no event will we offer to sell, pursuant to the registration statement of which this prospectus supplement forms a part, securities in a public primary offering with a value exceeding one-third of our public float in any 12-month calendar period so long as the aggregate market value of our outstanding common stock held by non-affiliates remains below \$75 million. During the prior 12-calendar-month period that ends on, and includes, the date of this prospectus supplement, we have sold \$12,896,813 of shares of common stock pursuant to General Instruction I.B.6 of Form S-3.

Our common stock is listed on The Nasdaq Capital Market under the symbol “ICU.” On November 17, 2025, the last reported sale price of our common stock on The Nasdaq Capital Market was \$0.3031 per share.

Investing in our securities involves a high degree of risk. See “Risk Factors” beginning on page 3 of the Prospectus, the “Risk Factors” section in our most recent Annual Report on Form 10-K, which is incorporated by reference into this prospectus supplement and the Prospectus, and under similar headings in the other documents that are filed after the date hereof and incorporated by reference into this prospectus supplement and the 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 supplement or the Prospectus. Any representation to the contrary is a criminal offense.

H.C. Wainwright & Co.

The date of this prospectus supplement is November 20, 2025.