Abstract: We study a mechanism design problem in which an indivisible good is auctioned to multiple bidders for each of whom it has a private value that is unknown to the seller and the other bidders. The agents perceive the ensemble of all bidder values as a random vector governed by an ambiguous probability distribution, which belongs to a commonly known ambiguity set. The seller aims to design a revenue-maximizing mechanism that is not only immunized against the ambiguity of the bidder values, but also against the uncertainty about the bidders' attitude toward ambiguity. We argue that the seller achieves this goal by maximizing the worst-case expected revenue across all value distributions in the ambiguity set and by positing that the bidders have Knightian preferences. For ambiguity sets containing all distributions supported on a hypercube, we show that the Vickrey auction is the unique mechanism that is optimal, efficient, and Pareto robustly optimal. If the bidders' values are additionally known to be independent, then the revenue of the (unknown) optimal mechanism does not exceed that of a second-price auction with only one additional bidder. For ambiguity sets under which the bidders' values are dependent and characterized through moment bounds, on the other hand, we provide a new class of randomized mechanisms, the highest-bidder lotteries, whose revenues cannot be matched by any second-price auction with a constant number of additional bidders. Moreover, we show that the optimal highest-bidder lottery is a 2-approximation of the (unknown) optimal mechanism, whereas the best second-price auction fails to provide any constant-factor approximation guarantee.