In this paper we present a method for simultaneously segmenting brain tumors and an extensive set of organs-at-risk for radiation therapy planning of glioblastomas. The method combines a contrast-adaptive generative model for whole-brain segmentation with a new spatial regularization model of tumor shape using convolutional restricted Boltzmann machines. We demonstrate experimentally that the method is able to adapt to image acquisitions that differ substantially from any available training data, ensuring its applicability across treatment sites; that its tumor segmentation accuracy is comparable to that of the current state of the art; and that it captures most organs-at-risk sufficiently well for radiation therapy planning purposes. The proposed method may be a valuable step towards automating the delineation of brain tumors and organs-at-risk in glioblastoma patients undergoing radiation therapy.