**APPENDIX S1**

**Prescriptive Support Vector Machines (P-SVM)**

**Predictions**. Prescriptive Support Vector Machines (P-SVM) is a prescriptive method that is based on Sparse Linear SVM (SLSVM). To formulate the SLSVM problem, let , denote the (dimensional positive samples, where is the dimensional vector of variables for sample and the class label. Similarly, denote the negative samples (patients who are not re-admitted within 30 days) with . Let be the vector orthogonal to the SVM hyperplane. Let also be a parameter controlling the level of sparsity. Training a classifier amounts to selecting so that the margin of the hyperplane is maximized:

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This is a convex quadratic optimization problem and can be solved very efficiently for large training sets involving thousands of patients. Let be an optimal solution of the problem above. Then, for a patient represented with a vector of variables we compute and compare it with some threshold. If this value is above the threshold, we predict that the patient will be re-admitted. Otherwise, we predict it will not. The threshold can be set using cross-validation given a desirable false positive probability.

**Prescriptions**. Fixing the hyperplane we next consider each patient in the training set and seek to optimize the value of “actionable” variables , for , where is the index set of actionable variables, so as to “flip” the patient to the negative side of the hyperplane. To that end, we solve the following convex optimization problem. The objective is a linear combination of a penalty for not placing the patient on the negative side of the hyperplane and a penalty for altering the values of the variables characterizing the patient:

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where denotes the p-norm, and are lower and upper bounds on the actionable variables, and is a parameter trading-off the two penalty terms in the objective. The parameter can be determined by validating the performance of the prescription determined by the above formulation in a validation dataset. After we fix we can solve the above problem for each patient in the test set to determine the optimal value of the actionable variables.