To provide clinicians and health care administrators with a greater understanding of the combined costs associated with the many critical care pathways associated with End Stage Renal Disease (ESRD), a system dynamics model was designed to simulate the total expenses of ESRD treatment for the United States, as well as incidence and mortality rates associated with different critical care pathways: kidney transplant, hemodialysis, peritoneal dialysis, and conservative care. Calibrated to United States Renal Data System (USRDS) 2013 Annual Report and the U.S Census Bureau for the years 2005 to 2010, encompassing all ESRD patients under treatment in the US from 2005 to 2010, the ESRD Population Model predicts the growth and costs of ESRD treatment type populations using historical patterns. The model has been calibrated against the output of the USRD's own prediction for the year 2020 and also tested by running historic scenarios and comparing the output to existing data. Using an interface designed to allow users to alter certain combinations of parameters, several types of scenarios can be run to project future spending, incidence and mortalities if certain combinations of critical care pathways are pursued. These scenarios include: a doubling of kidney donations and transplant rates, a marked increase in the offering of peritoneal dialysis, and an increase in conservative care routes for patients over 65. The results of these scenario runs are shared, demonstrating sizable cost savings and increased survival rates. Implications of clinical practice, public policy and further research are drawn.