Introduction
Adaptable shape models of critical cardiovascular anatomy sections have been developed to accelerate population-oriented studies of pathological morphology. To investigate aortic valve function, a parametric model of the left ventricular outflow tract-to-ascending aorta (LVOT-to-AA) region was developed utilizing Dassault Systemes’ modeling software SolidWorks. This parametric model facilitates incremental changes for studying patient population variances and disease progression. The LVOT-to-AA model was dissected using a novel geometry-specific method so that mold-sets could be developed. Fabricating these mold-sets using 3D-printing techniques allowed the model to be cast in parts. A LVOT-to-AA silicone phantom was produced using transparent silicone for use in a mock circulatory system (MCS) for analysis. An aortic root silicone phantom investigation box was fabricated out of transparent acrylic plate and fittings.

Materials and Methods

• LVOT-to-AA sparse spatial data was received from the Visible Human Project (VHP).
• This model was used to generate a clinical data-based parametric model of the structure, allowing for incremental structural changes useful for studying (1) time-dependent structural progression due to age or disease and (2) structural variation from population to population.

Results
Using published data, correlation equations were derived and implemented to allow for prediction of aortic valve structure, based on gender, age, height, and weight. Mold sets were fabricated so that a silicone phantom could be created. A visualization system acrylic box module was fabricated in order to integrate silicone phantoms into a mock circulatory system for use with particle image velocimetry (PIV) flow analysis.

Conclusion
A method of generating a continuous LVOT-to-AA parametric model has been successfully developed and carried out.

Future Research
Broadening the functionality of the parametric valve would allow for more accurate prediction models by allowing greater control over the various components of the LVOT-to-AA model. Applying a unified and comprehensive data set, describing the anatomical structure dimensions as a function of time, to the parametric model design table would allow for improved modeling ability.

References

Keywords: Aortic Root, Parametric, MCS, PIV, Mold Set, Silicone, Spatial Scaling