**A Computer Model of the Human Heart’s Electrical Activity for Validation of Implantable Cardioverter-Defibrillators**

*Abstract:*  
**Introduction:**  
Before the clinical trial stage, the efficacy of implantable Cardioverter-Defibrillators (ICDs) can be studied by running a database of electrograms through the device. However electrogram datasets are scarce and must be manually adjudicated. We sought to create a computer model of the heart’s electrical activity suitable for evaluating the performance of an ICD and that is fast to simulate, produces a wide variety of arrhythmia episodes, and whose episodes are automatically adjudicated.

**Methods:**  
N/A

**Results:**  
The structure of our computer model is as follows: we assign a *vertex* to a few key locations in the heart such as the SinoAtrial (SA) and Atrio-Ventricular (AV) nodes, and to locations involved in tachycardias such as re-entrant circuits and irritable foci (Figure). Each vertex has 2 timing parameters: Rest and Effective Refractory Period. The tissue between vertices is modeled as two propagation delays: Ante (models the delay of antegrade propagation between the 2 vertices) and Retro (models the retrograde propagation delay). By varying these periods and delays within accepted physiological ranges, we simulate the rates of various arrhythmias (atrial fibrillation and flutter, other SVT, sustained and non-sustained VT, VF) including various relations between atrial and ventricular rates. We then used stored patient electrogram data to create simulated electrograms at the rates produced by the model. With this model we simulated 11,400 episodes including rare conditions like double tachy.

**Conclusion:**  
This model allows fast simulation of arrhythmias and is used to test the efficacy of ICDs with large simulated datasets containing 1000s of episodes.

