Strategic Development of Polymer Lung Surfactant

Prior to the invention of therapeutic lung surfactants, neonatal respiratory distress syndrome (NRDS) was the leading cause of infant death in the United States with higher death rate than pneumonia and influenza. The successful translation of knowledge in basic science to clinical practices has led to the discovery of animal-extracted therapeutic lung surfactants. Now-a-days, therapeutic lung surfactants are saving the lives of 40,000 NRDS infants every year in the US alone. The life-saving treatment using therapeutic lung surfactants has further potential in annually treating 265,000 premature infants that have mild respiratory distress, and 190,000 acute respiratory distress syndrome (ARDS) adult patients (US patient populations). The annual US market size of the two treatments are projected to be about $ 120 million and $ 4 billion, respectively. Evidenced by past failed clinical trials, to expand the indications of therapeutic lung surfactants to mild NRDS premature infants and ARDS patients, the physicochemical properties of the current therapeutics need to be modified. Although the limitations of the current therapeutics have been known since the 1990s, for the past two decades, there has not been much improvement in the formulations. A radically different approach was attempted where instead of using the conventional lipid and protein based formulations, synthetic biocompatible polymers were selected as the main active ingredient. This thesis details the endeavor, driven by engineering curiosity and a humanitarian agenda, to embark upon a venture to develop the world's first polymer based synthetic lung surfactant.