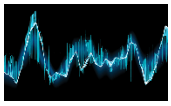
	Minimizing Ambulatory Vibrations – Group 8	**Quality System Procedure Form**	
		Doc. No: 1	Rev. No: 5
		Date: 4/3/18	Status: Draft

Design Brief

Approved by:	**Date:**
Michael Adams	4/3/18
Sid Bala	4/3/18
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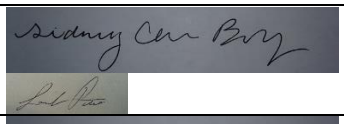
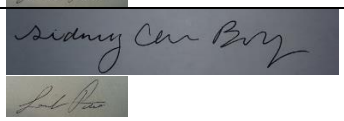
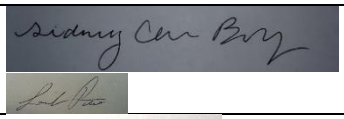
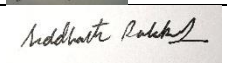
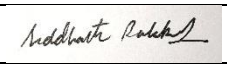
CHANGE RECORD:

Rev	**Date**	**Description of Change**	**Authorization**
1	10/19/17	Initial Draft	
2	10/24/17	Removed reference to Children's Hospital. Added more detailed clinical relevance and background analysis information. Noted sections that still need to be included.	
3	12/10/17	Added sections that had been indicated on previous revision (introduction paragraph and appendix) and proofread the section.	
4	1/14/18	Small changes in wording to clarify certain subjects.	
5	4/3/18	Small changes in wording.	

Introduction:

During emergency transportation situations, patients are exposed to consistent and often severe vibrations. While undesirable for all patients, this is particularly dangerous for newborn infants. Studies have shown that the vibrations transferred to infants during transport by emergency vehicles can cause serious complications. Despite extensive research characterizing these vibrations, no commercially viable product has been brought to market. Our solution aims to enhance the standard neonate transportation incubator using a cost-effective, accessible solution. More specifically, our product implements affordable passive vibration damping materials to minimize the forces transferred to the neonate during transportation.

Design Brief:

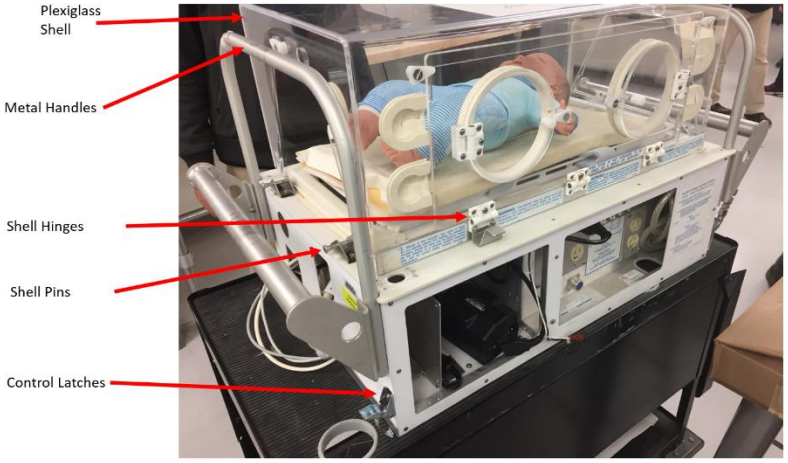
Currently during emergency neonatal transport, there is a large displacement of the infant though vibrations. In ambulance and helicopter transport, this is mainly due to large mechanical disruptions that are unavoidable. The rotation of helicopter blades, wind gusts, pot holes in the road, and erratic driving create a dangerous environment while transporting a patient. This is especially hazardous for infants. Infants have a small mass and cannot resist outside perturbations. They do not have control over their body and cannot hold themselves in place to prevent motions. Their lack of awareness makes it impossible for them to respond to sensory inputs and react to any outside disturbances. Additionally, the need for emergency transport indicates the infant is in need of critical care, which is only exasperated by outside disturbances.

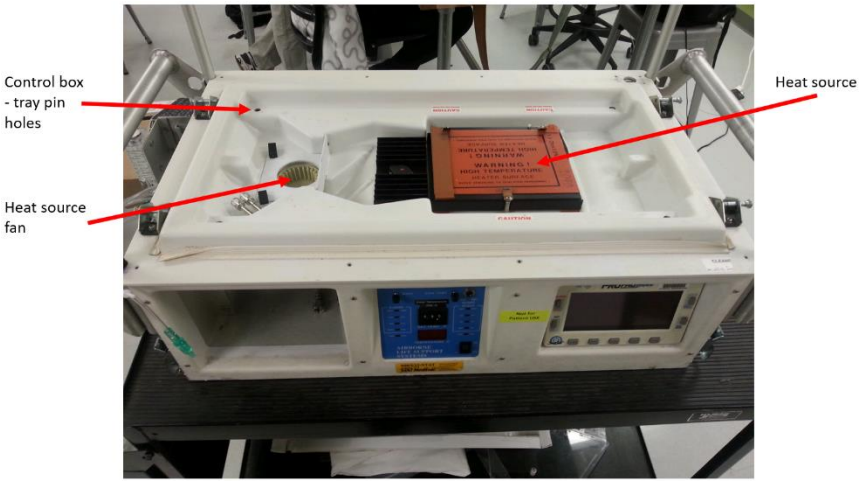
Infants are highly susceptible to damage from these sudden movements. Researchers from the US National Inpatient Sample Database found that premature infants have a larger risk of ventricular and germinal matrix hemorrhage during ground and air emergency transport. It has been consistently seen that sudden, loud sounds increase heart rate, respiration, intracranial pressure, and a decrease in oxygenation level. All of these symptoms could cause serious damage for infants in critical condition.

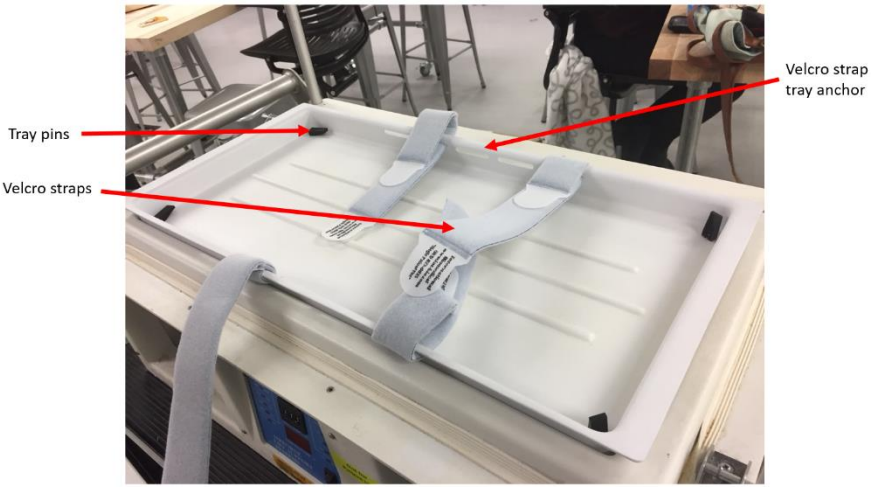
In addition to these dangers, any disturbances the ambulance/helicopter encounters are amplified by the current stretcher-box configuration. The stretcher is bolted to two large rectangular boxes that house medical care for the infant and pinned on top of this is an incubator that houses the infant (see appendix below for visual guide). Due to these rigid connections, any movement that affects the stretcher is amplified when it reaches the infant. Initial data analysis indicates that the power spectral density of vibrations on the tray bed of the incubator are higher than those at the base of the incubator.

In order to protect these infants, the afflicting vibrations must be minimized. While there is extensive research in this field, no viable solution has been produced, leaving a large unmet need for this critical population. The solution should directly address the control/incubator components and not affect the stretcher, for regulation reasons. The solution should reduce vertical displacements that commonly occur during ambulatory emergency transport without providing any additional risks to the patients' well-being. This could be accomplished through a passive method, such as dampers or isolators, or with an active component such as a developed control system that opposes the vibrations present.

Appendix:


Plexiglass Shell
Metal Handles
Shell Hinges
Shell Pins
Control Latches


Control box - tray pin holes
Heat source fan
Heat source


Tray pins
Velcro straps
Velcro strap tray anchor