Project Title: Neonatal Monitor to Prevent Sudden Infant Death Syndrome (SIDS)

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Design Request

This proposal is to request the design of a device to prevent the Sudden Infant Death Syndrome. The new device should monitor at least three vital parameters (heart rate, temperature and oxygen saturation in blood) of a baby during sleep. The device should be equipped with an alarm system to be activated in case of low heart rate, hypothermia or apnea.

Justification

_Sudden Infant Death Syndrome (SIDS)._ The National Institute of Child Health and Human Development [1] defines *Sudden Infant Death Syndrome* as "the diagnosis given for the sudden death of an infant under 1 year of age that remains unexplained after a complete investigation, which includes an autopsy, examination of the death scene, and review of the symptoms or illnesses the infant had prior to dying and any other pertinent medical history." SIDS is the leading cause of death in infants between 1 month and 1 year of age, with most SIDS deaths occurring between 1 and 4 months of age. SIDS kills 3 out of every 2,000 infants.

_Risk Factors._ A number of factors seem to put a baby at higher risk of dying from SIDS. These include: Babies who sleep on their stomachs, mothers who smoke during pregnancy are 3 times more likely to have a SIDS baby, exposure to passive smoke from smoking by mothers, fathers, and others in the household doubles a baby's risk of SIDS, mothers who are less than 20 years old at the time of their first pregnancy, babies born to mothers who had no or late prenatal care, premature or low birth weight babies.

_Causes._ Mounting evidence suggests that some SIDS babies are born with brain abnormalities that make them vulnerable to sudden death during infancy. Studies of SIDS victims reveal that many SIDS infants have abnormalities in the arcuate nucleus, a portion of the brain that is likely to be involved in controlling breathing and waking during sleep. Babies born with defects in other portions of the brain or body may also be more prone to a sudden death. These abnormalities may stem from prenatal exposure to a toxic substance (cf. teratogens), or lack of a vital compound in the prenatal environment, such as sufficient oxygen. Cigarette smoking during pregnancy, for example, can reduce the amount of oxygen the foetus receives. However, scientists believe that the abnormalities that are present at birth may not be sufficient to cause death. Other possibly important events, which occur after birth, may include a lack of oxygen, excessive carbon dioxide intake, overheating or an infection. The numbers of cells and proteins generated by the immune system of some SIDS babies have been
reported to be higher than normal. Some of these proteins can interact with the brain to alter heart rate and breathing during sleep, or can put the baby into a deep sleep. Such effects might be strong enough to cause the baby's death, particularly if the baby has an underlying brain defect. Some babies who die suddenly may be born with a metabolic disorder. One such disorder is medium chain acylCoA dehydrogenase deficiency, which prevents the infant from properly processing fatty acids. A build-up of these acid metabolites could eventually lead to a rapid and fatal disruption in breathing and heart functioning.

**Required Specifications**

The new device should be able to monitor, store and analyze three vital parameters on a baby under 1 year of age: heart rate, oxygen saturation and temperature. The sensors of the system should be small enough to avoid disturbing the baby to sleep. The use of gel or electrodes causing skin's irritation should be prevented. The new device should have an alarm to indicate a significant change in any of the three vital parameters measured. The parameter's threshold to initiate an alarm signal must be selectable by the user. The minimal size, weight and cost for the new device is requested. Also, the design should meet the electrical regulations and safety for medical devices.

**Desired Specifications**

As further improvements, the device might monitor (a) whether the baby sleep on its back as opposed to its stomach, (b) the quality of the air (smoke-free environment) (c) keep the records to analyze the trends of the measured parameters.