### Introduction / Project Background:

**Pneumothorax:**
- Occurs when air leaks into the space between the pleural surfaces
- Life threatening situation when open pneumothorax develops into tension pneumothorax (PTx)
- Remedy: Vented seals regulate air entry or exit through the pleural cavity to relieve tension.

**Phase I study:**
- In a first phase study of 17 different chest seals with optimal air flow and new material, we down-selected the best performing vented and non-vented chest seals based on adhesive properties. [2013 MHRS poster presentation]
- Kheirabadi et al. has demonstrated that only vented chest seals can prevent pneumothorax from developing into IP Tx. [Kheirabadi et al 2013].

**Battlefield situation:**
- Exposure to extreme environmental conditions can be encountered.

**Objectives:**
- Evaluation of the effects of exposure at extreme hot and cold temperatures on the adhesive properties of the downselected vented chest seals.

### Results/Accomplishments:

#### Evaluation Methods:

**Swine Skin Model Adhesion Experimentation:**
- Quantitative measurements for the detachment of the seal from the pig skin using:
  - Peeling technique: Percent adherence of the horizontal unbound portion of the seal that started detaching from the skin.
  - Suction technique: Detachment level: fluid displaced for the seal to detach without breaking the air tight sealing. Breaching level: fluid displaced for compromising the airtight sealing.

**Temperature exposure:**
- Cold: 18.5 ± 1.9 hours at -19.5 ± 1.3 °C
- Hot: 17.7 ± 1.5 hours at 71.5 ± 2.0 °C

#### Technology:

**Down-selected vented seals:**
- Vented chest seal
- 5 non-vented seals considered for testing

**Valve/vent:**
- Protruding 3-ball valves
- Protruding Multichannel
- Flat middle Vent
- Flat protruding Valve
- Flat side Vent

**Product:**
- Bolin® CS
- Fast Breathe® CS
- Russel® CS
- SAM® CS
- Hyfin® CS

**Overall:**
- Product: Best Overall
- Red: Medium
- Medium: Medium
- Medium: Medium
- Medium: Medium
- Medium: Medium

#### Conclusions:

- Adhesion of vented seals to skin were maintained after an average exposure of 18 hours at extreme temperatures of hot (71.5 °C) or cold (-19.5 °C). Adhesion was slightly less for the Bolin® chest seal; this was attributed to coarse swine hair.
- Exposure to hot temperature had a tendency to "melt" the adhesives causing glue to remain on the skin; in particular for the SAM® chest seal, Hyfin® chest seal, and Fast Breathe® chest seal. Seal removal was very difficult in these cases.
- Other qualitative characteristics may be considered for more specific down-selection.

#### Project Future:

- Live-animal experimental hemodynamic/respiratory physiology testing will assess the valve/vent type for best performance of vented seals. This will be conducted at USAISR.

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