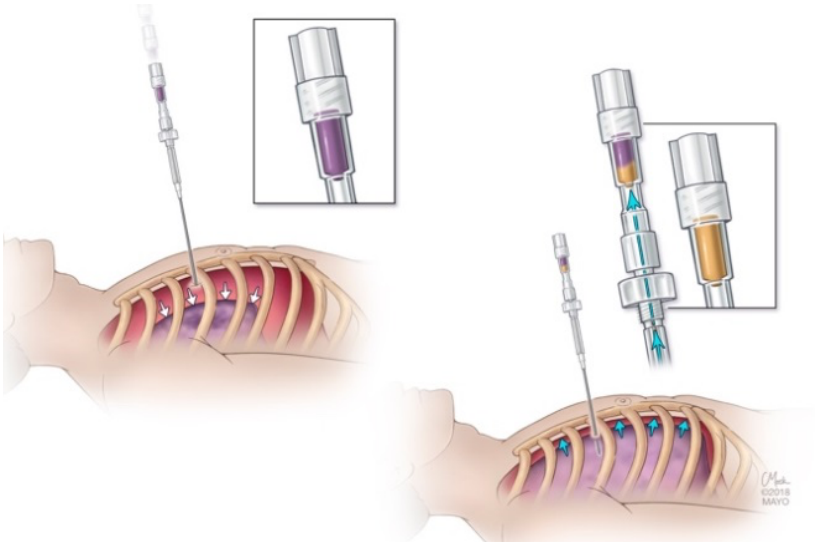
Tension Pneumothorax Decompression with Needle Thoracostomy Colorimetric Capnography

Background: Trauma is a significant cause of reduced life years and mortality in both military and civilian populations. Tension pneumothoraces comprise a mixture of respired gases at pressures higher than atmospheric, and arise from air leaks within the respiratory system. Increasing volume of the pneumothorax increases intrathoracic pressure relative to cardiac filling pressures in the right atrium, leading to inflow failure, subsequent outflow failure, and eventual cardiopulmonary decompensation and death.

Rapid decompression of tension pneumothorax, via needle thoracostomy (NT), is a lifesaving maneuver allowing intrathoracic and atmospheric pressure equilibration and restoration of cardiac filling. While the technique appears simple, the data regarding the efficacy of needle decompression is controversial. Even if all the major variable factors such as chest wall thickness, anatomic location, optimal rigidity of the decompression catheter, and catheter length are accounted for, it remains difficult for field providers to rapidly confirm therapeutic decompression. *Current guidelines recommend operators utilize auditory cues for a "gush of air" and to assess for improvements in vital signs and cardiorespiratory function in an austere loud prehospital environment which is often impossible.*

Detection and *visual* recognition of respired gases during decompression is a simple method for improving needle thoracostomy. The gaseous composition of the tension pneumothorax is similar to that of end-respiratory gas, with an increased partial pressure of carbon dioxide when compared to the normal atmosphere, which makes colorimetric capnography an ideal confirmatory test.



Approach: We have developed a novel device based on colorimetric capnography to assist providers in rapid and accurate confirmation of needle thoracostomy placement. Immediate confirmation of success or failure of placement should result in immediate treatment; therefore, this device carries the potential to decrease the rate of mortality in combat situations. In previous work, our team generated and utilized a swine model of penetrating thoracic trauma to model tension pneumothorax physiology. We demonstrated that by incorporation of colorimetric capnography into the decompression device, needle thoracostomy led to improved success rates of decompression and earlier detection of success compared to currently used standard of care metrics. Additionally, we have conducted first in man pilot studies which demonstrate similar results in trauma patients.

Path forward: The Pneumeric, Inc team has exclusively licensed the technology from Mayo Clinic and is undergoing FDA regulatory scrutiny and minor manufacturing improvements. Human clinical data has confirmed previous results from animal studies, providing a basis for broader fielding both in the military and civilian sector. This simple device has clear applicability for first responders and combat casualty caregivers, supplying rapid visual feedback to ensure that a tension pneumothorax has been objectively decompressed in the field. In field care, this device would be an exceptional tool to save lives.

For more information, please visit https://www.pneumeric-medical.com or scan the QR code.