What is ZOE®?

- **ZOE®** is a noninvasive monitor that measures fluid status via thoracic bioimpedance.
- **ZOE®** measures Zo; an objective measure of fluid status in the thoracic cavity referred to as thoracic electrical bioimpedance (TEB) or the change in resistance due to fluid changes. Ohm (Ω) is the unit of measure.
- Base impedance is referred to as Z-naught or Zo.
Bioimpedance

- Greater impedance equates to a more dry or dehydrated state.

- Less resistance represents more fluid or overhydration.

- 30Ω or higher

- 19Ω or lower
History of Bioimpedance

- First known measurement of noninvasive bioimpedance was 1960’s
- Total body impedance, determining total fat vs. total lean body content, started in the 1980’s
- Base Thoracic impedance (Zo) has been measured on the IQ Noninvasive Hemodynamic Monitor or Cardioplethsmograph since 1992
Why is Zo Important?

- Zo has been measured for years on the IQ cardioplethsmograph indicating fluid volume in the thorax.
- Milzman, in 1996, found that patients in the ED with a Zo less than 15 exhibited pulmonary edema, prompting Milzman to name Zo the noninvasive chest x-ray.
- In 2000, Cleveland Clinic replicated Milzman’s study regarding Zo.
Why is Zo Important

- Zo is a sensitive measurement, indicating fluid retention in heart failure patients as early as 12 days before symptom development or weight gain.

![Graph showing Zo values over time]

- December 23: weight 186
- January 12: weight 187
- January 20: weight 187
- January 22: weight 193, crackles 1/3 up, Demedex 80mg
Why is Zo Important?

- Intrathoracic Zo measurement, an invasive procedure, also found Zo to be an early predictor of fluid congestion among heart failure patients.
- Zo was found to be a better early predictor of fluid congestion than pulmonary wedge pressure.

Cheuk-Man Yu, Li Wang, Elaine Chau, Raymond Chan, Shun-Ling Kong, Robert W. Stadler, Chu-Pak Lau. Department of Medicine and Therapeutics, Prince of Wales Hospital, Hong Kong; Cardiac Rhythm Management, Medtronic, Inc., Minneapolis, MN; Department of Medicine, Grantham Hospital, Hong Kong; Department of Medicine, Queen Mary Hospital, Hong Kong
What is the Zo Range?

DRY

2 ohm decrease within 24 hours dictates action.

WET

34 ohms
30 ohms
19 ohms
15 ohms

2 ohm decrease within 24 hours dictates action.
Monitoring Zo

- Same time every morning
- Morning is the best time for daily monitoring – before breakfast, after first void
- Zo monitoring log found in the back of the ZOE User Manual
Zo Saves Exacerbation

<table>
<thead>
<tr>
<th>Early S&amp;S Exacerbation</th>
<th>Late S&amp;S Exacerbation</th>
<th>Acute Exacerbation</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Appetite</td>
<td>↑ Peripheral edema</td>
<td>Pitting edema</td>
</tr>
<tr>
<td>Fatigue</td>
<td>↑ SOB with exertion</td>
<td>↑ SOB @ rest</td>
</tr>
<tr>
<td>Bloated feeling</td>
<td>Weight gain</td>
<td>Develops S3</td>
</tr>
<tr>
<td>Fullness in ears</td>
<td>↑ Abdominal girth</td>
<td>Develops crackles</td>
</tr>
<tr>
<td>Difficulty Sleeping</td>
<td>↑ Pillow use</td>
<td>SaO2 ↓</td>
</tr>
<tr>
<td>↓ Zo</td>
<td></td>
<td>JVD</td>
</tr>
<tr>
<td>(≤ 2 ohms in 24°)</td>
<td></td>
<td>Zo less than 15 ohms</td>
</tr>
</tbody>
</table>

This is when home care nursing intervention must occur to prevent CHF and hospitalization.
Zo Saves Time & Money

- Because Zo identifies an early trend toward exacerbation, clinicians can act early to avoid time and cost associated with unscheduled home visits.
- Patients avoid time and money spent on emergent or acute care access.
- Home care agencies benefit from reduced emergent care and acute care access outcomes.
  (see Home Health Compare:  www.medicare.gov)
  http://www.medicare.gov/HHCompare/Home
- http://www.homehealthnews.org/category/clinical/
Recent Data

Telehealth & Technology, Quality & Outcomes, Quality & Best Practices, Clinical & Disease Management

314- Reduce Acute Care Hospitalization and Improve Clinical Outcomes for Congestive Heart Failure with Application of ZOE Fluid Status Monitor

Acute care hospitalization rates are impacted by a few home health clients with chronic conditions. The presenters provide information on how the selective utilization of ZOE fluid status monitors for home care patients are identified as frequent users of emergency care combined with physician orders, reducing acute care hospitalization rates dramatically.

Objectives:
Discuss the value of a ZOE fluid status monitor;
Describe the methodology supporting the medical science of bioimpedance in congestive heart failure; and
Identify characteristics of home care patients who would have improved outcomes with use of the fluid status monitor.

Faculty: Janet Colleran, BS, RN, Quality Improvement Manager, CHANS Home Health Care and Hspice, Brunswick, ME; Edward Schmidt, MD, Medical Director CHANS Home Health and Bowdoin Medical Group, Brunswick, ME;
Course Level: Intermediate; 1.5 nursing CEs (MNA Approval Pending);
Zo Indicates Dehydration

- **Hunting Project**
  - Zo measured in subjects pre & post meals and at bedtime
  - Zo changed with exertion and fluid replacement
  - Most consistent Zo measure was first in morning pre breakfast and after first void.

- **Weapons of Mass Destruction Exercise**
  - Zo measured pre and post exertion in hazmat suits
  - Zo changed as much as 58% in 45 minutes
  - Better indicator of dehydration than temperature, urine, or hematocrit
Zo Demonstrates Diuretic Efficacy

- Zo will begin to rise prior to urination after IV or oral diuretic
- Home care nurses do not have to revisit or call on patients to assure medication effect
Zo Indicates Dialysis Tolerance

- Albert Einstein Hospital Dialysis Clinic
  - Measured Zo and BNP pre and post peritoneal dialysis
  - Zo was a more sensitive measure in determining fluid volume
  - Zo was more indicative than BNP in heart muscle response to increased fluid volume
ZOE FDA Clearance

For Individuals with:

- Fluid Management Problems
- Taking Diuretic Medications
- Living with heart failure
- Living with End-Stage Renal Disease
- Suffering from Recurrent Dehydration
- Recovering from a Coronary Artery Disease Related Event
ZOE Clinical Trials

- ZOE placed on total of 120 patients
- Zo consistent with IQ measurement = 96%
- $R^2$ correlation coefficient = 0.996
- 92% patients ranked ZOE as “Very Easy to Use” and 4% ranked ZOE as “Easy to Use”
- 2% ranked ZOE as “Somewhat hard”
  
  These patients had MS or a stroke
ZOE Clinical Uses

Class TWO Medical Device

- Home Care
- Disease Management
- Clinics
- Telehealth Systems
- First Aid
- EMS
How To Apply ZOE®

1. Connect the AC adapter into the ZOE® back and plug the device into an outlet, or insert batteries.

2. Snap the new NMT, Inc. electrodes to the ZOE® cable. White snap on the arrow tip and black snap on the arrow base.

3. Place Electrode 1 just above the top of the breastbone with the arrow tip pointing down.

4. Place Electrode 2 just below the bottom of the breastbone with arrow tip pointing up.

5. Wait 5 minutes – Press the “START” button.

6. Wait, without moving or drinking, for the Zo number to appear in the ZOE® window.
ZOE Device

- Patient cable
- Zo Display window
- Red Light – cable disconnect
- Blue Light - low battery
- Power cable
- Battery Compartment
- RS232 Port
ZOE ELECTRODES

- FDA mandates only ZOE electrodes for use with the ZOE Device
- Single use only
- Complex hard-to-manage heart failure patients require daily monitoring
ZOE Maintenance

- Spill proof not water resistant
- Wipe device and cable with bleach base solution between patients
- Recalibration with each use
- Annual maintenance checks
- Electrodes are single use/disposable
ZOE Power

- Must use AC Power cord that is provided in ZOE kit for FDA compliance
- Four AA batteries
- CSA mark good in North America
- CE mark good in Europe
ZOE® Accessories

- Soft side carrying case –
  - holds ZOE,
  - pocket for electrodes and batteries
  - Cleaned with bleach solution
- Extra ZOE cable
- Power cable
- ZOE instructional DVD
- ZOE Wipes
Connecting ZOE® to Telehealth

- ZOE® is a peripheral device that can interface with any telehealth system via a RS232 Port
- Serial data reported are the last ten Zo measurements
- Need to know from telehealth client:
  - What type of connection – serial, parallel, USB
  - If serial connection – male or female?
  - What is baud rate?
  - What is bit data? – start, stop and parity
ZOE® Contact Information

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www.nmtinc.org