Heart Failure Management How to Monitor

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- **Director**, Arrhythmia Services, Max Healthcare, India
- **President**, Indian Heart Rhythm Society

Symptoms: The Tip of the Congestion Iceberg in Heart Failure

Systemic congestion
(JVD, edema)

↑ RV + RA pressure

Increase PA pressure

Increased PCWP (congestion)

↑ LA and LV diastolic pressure

↑LVDP + Impaired volume regulation

Abnormal LV function (Sys and/or Dia)

↑ Hydrostatic pressure
↓ Oncotic pressure
↑ Permeability
Lymphatic drainage capacity
Alveolar-capillary membrane integrity

Abnormal lung function
Respiratory muscle dysfunction
Other factors

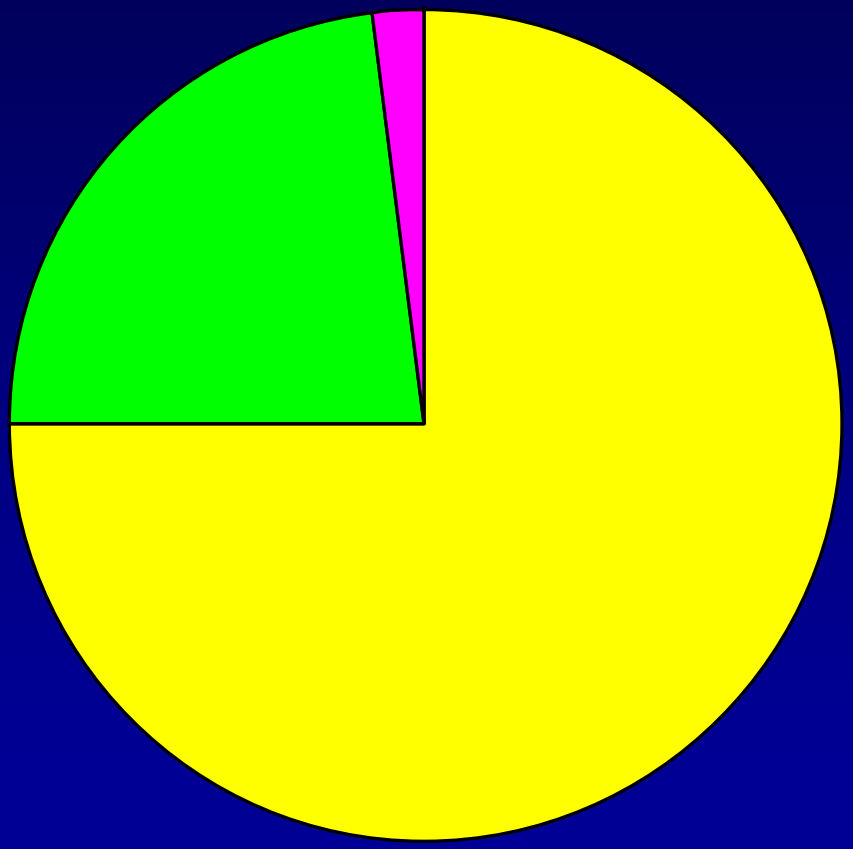
Dyspnea

Alveolar edema

Redistribution in pulmonary vascular bed + Interstitial edema

Mitral Regurgitation

Worsening Chronic Heart Failure: The Major Reason for Heart Failure Hospitalizations



- Worsening chronic heart failure (75%)
- De novo heart failure (23%)
- Advanced/ end-stage heart failure (2%)

Fonarow GC. Rev Cardiovasc Med. 2003; 4 (Suppl. 7): 21
Cleland JG et al. Eur Heart J. 2003; 24: 442

Clinical Need

Increased Congestion → HF progression

Increased Congestion → Increased Mortality

75 % of HF Hospitalizations → Congestion

HF Hospitalization → 1 year mortality – 33 %

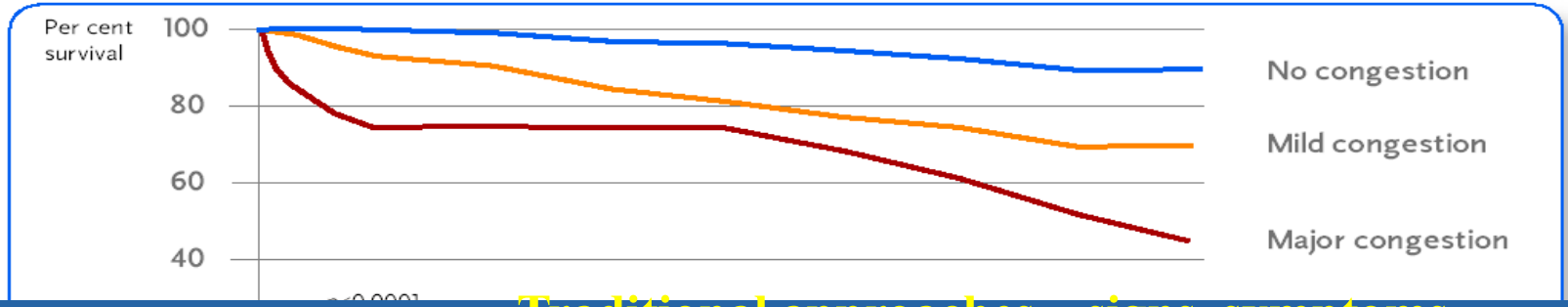
Predict Congestion Early

- Reduce hospitalizations
- Reduce mortality

Hemodynamic (high LVDP) congestion frequently develops several days or weeks before the onset of clinical symptoms and signs

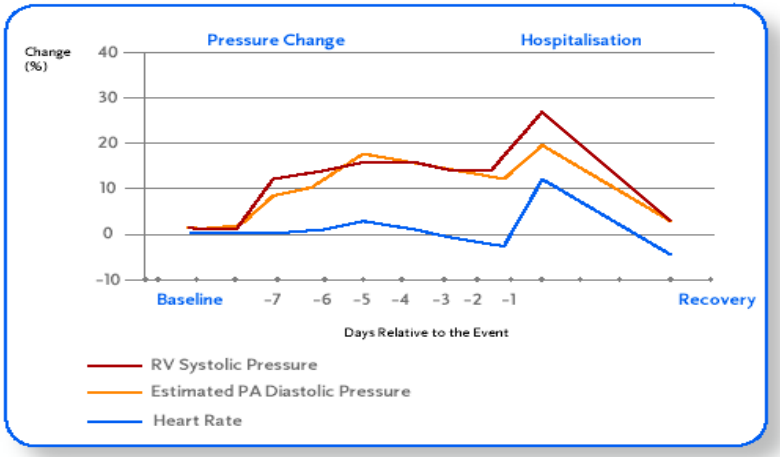
Clinical Need

Congestion significantly increases mortality[1]

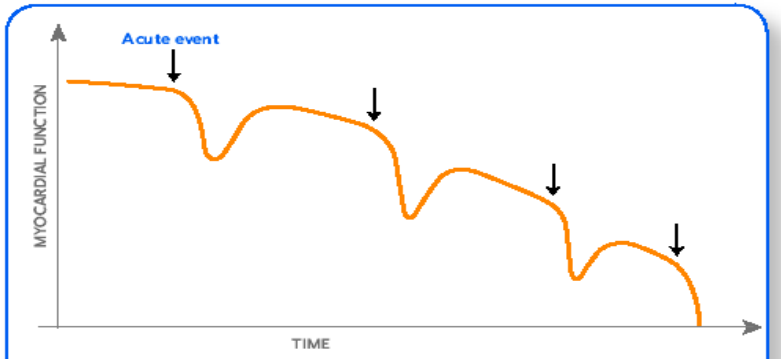


Traditional approaches – signs, symptoms, assessment of daily weights :have failed to improve hospitalization rates

Congestion leads to hospitalisations[2]



Staying out of hospital preserves cardiac function



With each admission of acute Heart Failure syndromes, there is a short-term improvement; however, the patient leaves the hospital with a further decrease in cardiac function.

Worsening Heart Failure → Pulmonary Congestion → Decreased Intrathoracic Electrical Impedance

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Impedance

Pulmonary Congestion

As fluid accumulates in the lungs, intrathoracic impedance decreases

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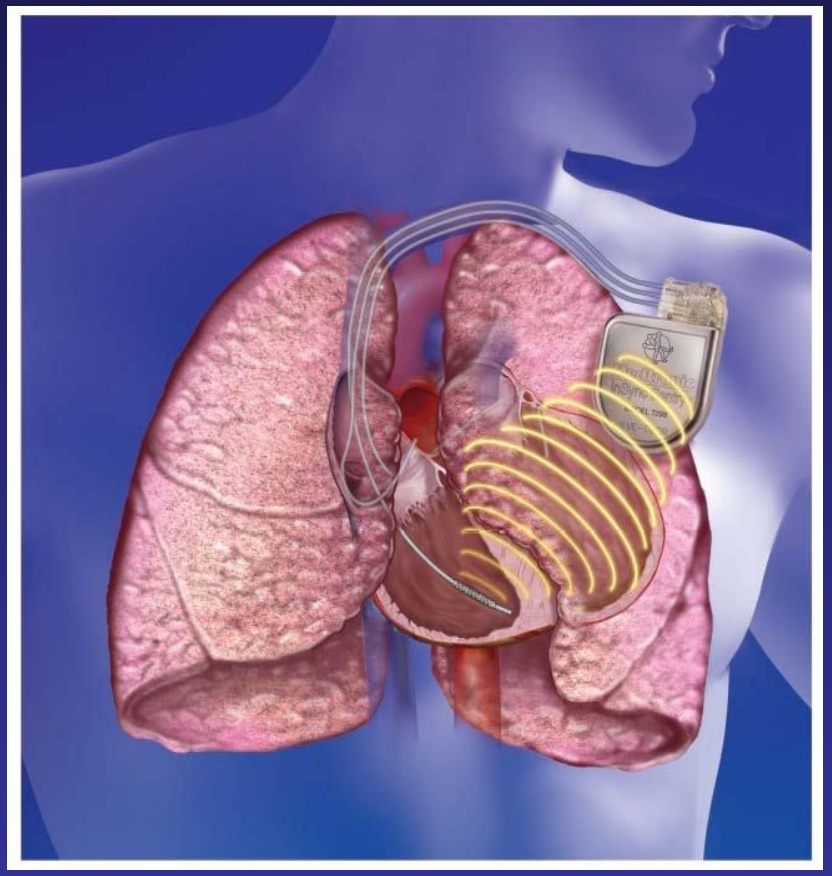
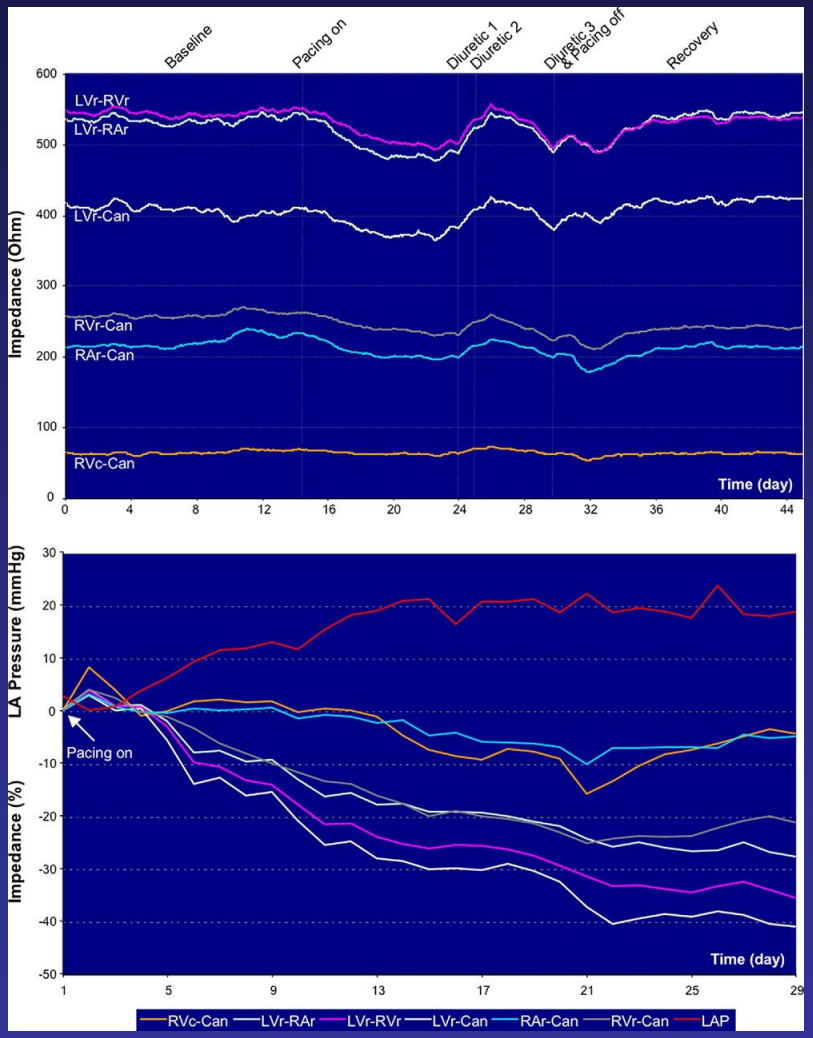


Impedance

Normal Lungs

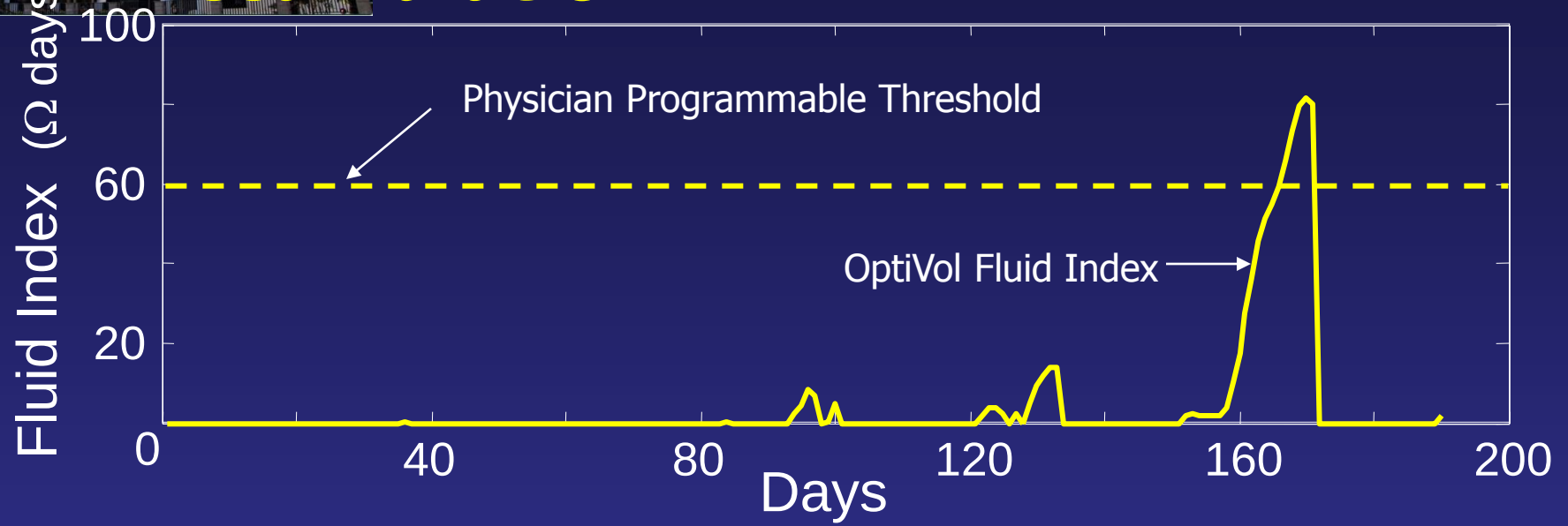
As the lungs clear, intrathoracic impedance increases

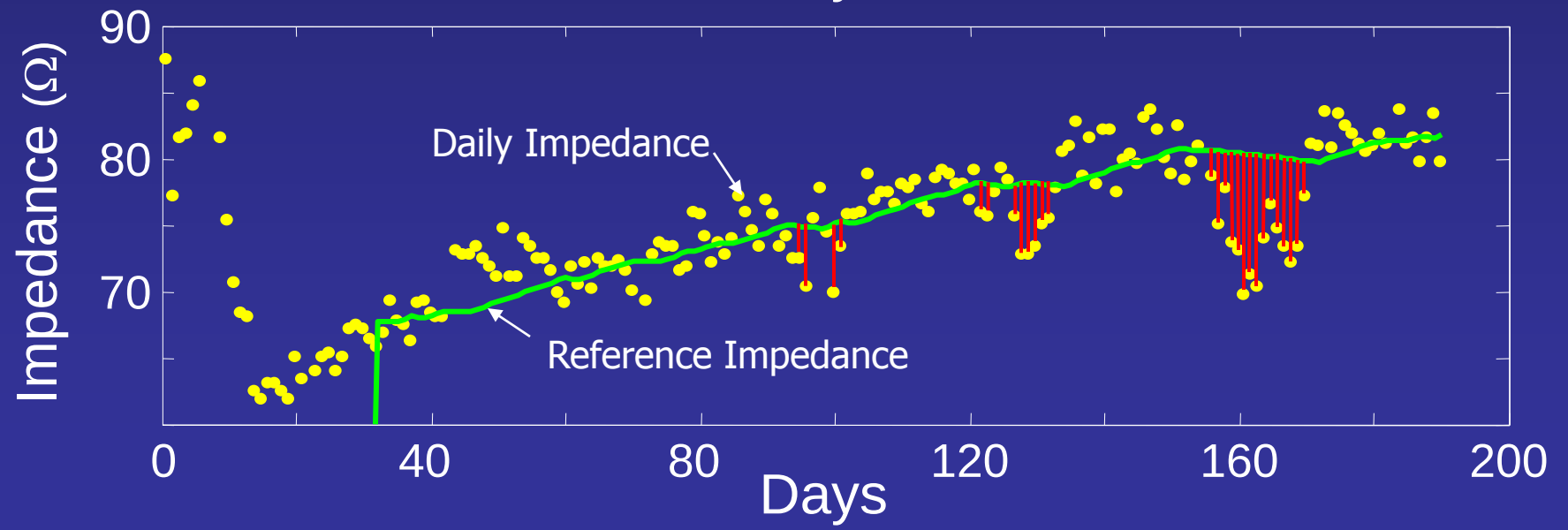
Impedance Trends at Different Stages of the Model



Khoury, D. S. et al. J Am Coll Cardiol 2009;53:1075-1081

Algorithm Developed to Track Fluid Accumulation





Technological Solution - Optivol

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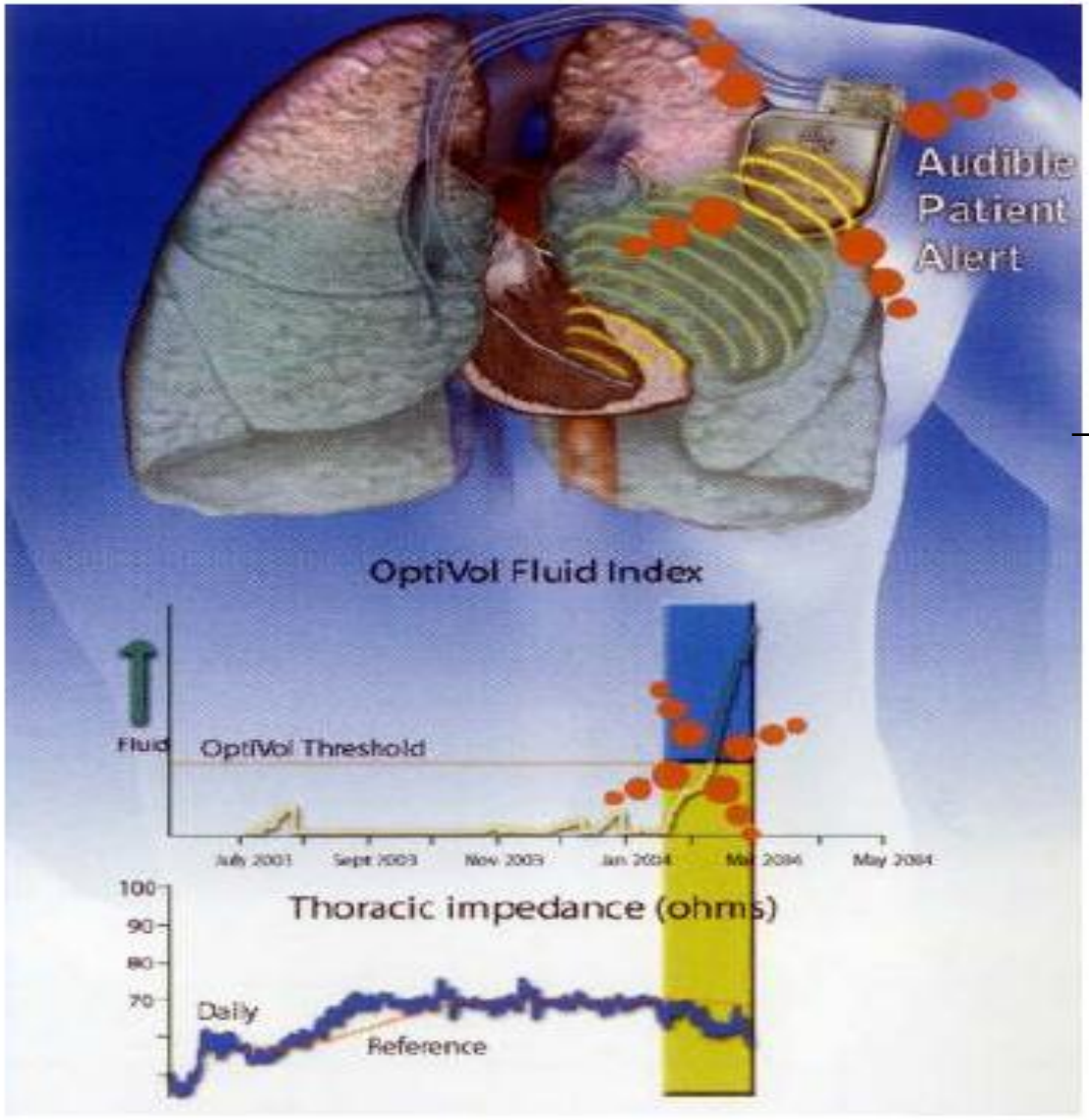
High Impedance

Less Fluid

Low Impedance

More Fluid



Optivol Clinical Results

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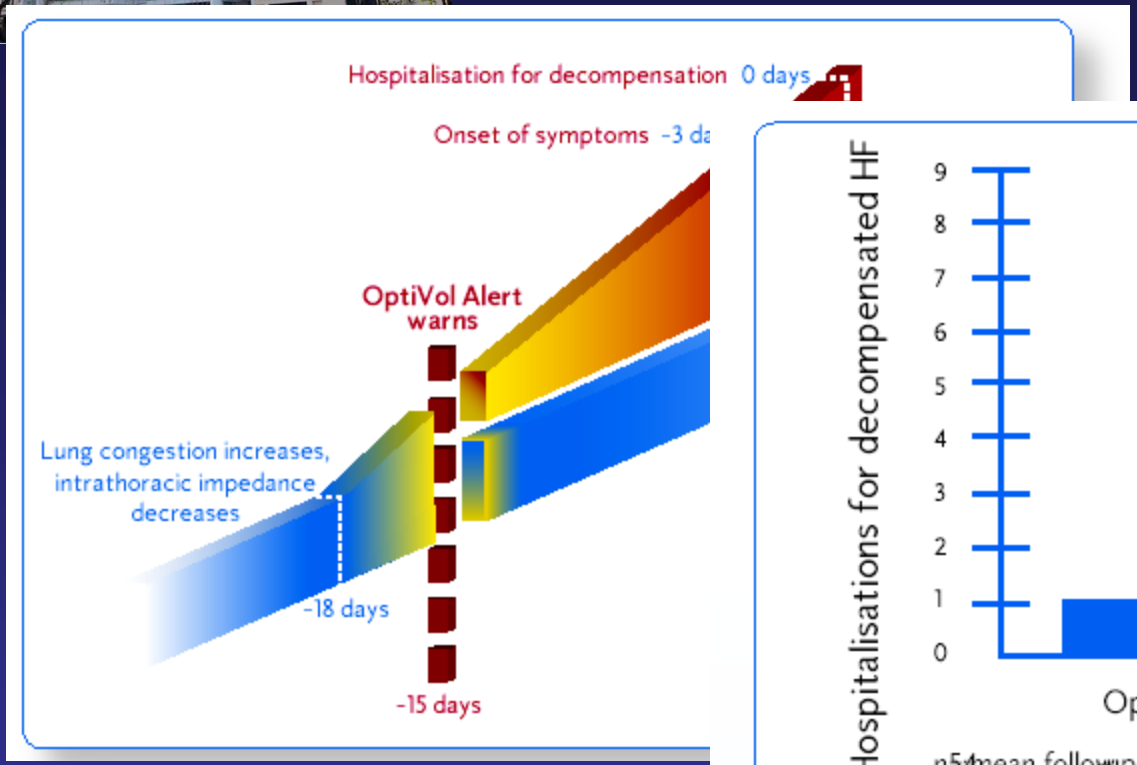

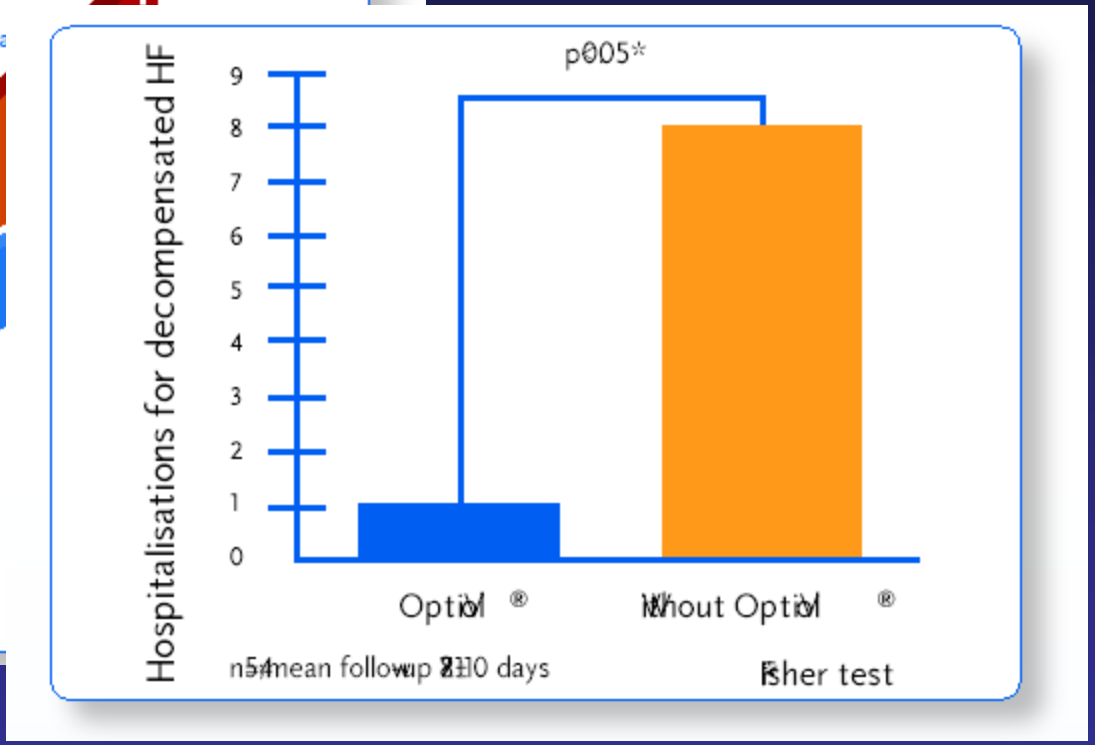

77 % sensitivity
75% alerts related to clinical events

1 Yu et al. Circulation 2005; 112:841-848
2 Maines et al. Heart Rhythm Society. 2006 Scientific Sessions; May 19, 2006; Boston, MA. Abstract AB48-4
3 Vollmann et al. Eur Heart J 2007; epub

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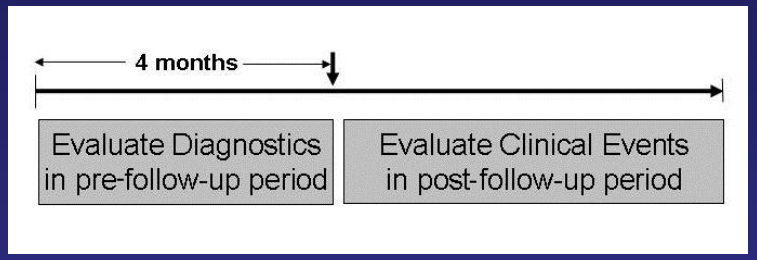
Journal of Cardiac Failure Vol. ■ No. ■ 2009

Changes in Intrathoracic Impedance are Associated with Subsequent Risk of Hospitalizations for Acute Decompensated Heart Failure: Clinical Utility of Implanted Device Monitoring without a Patient Alert

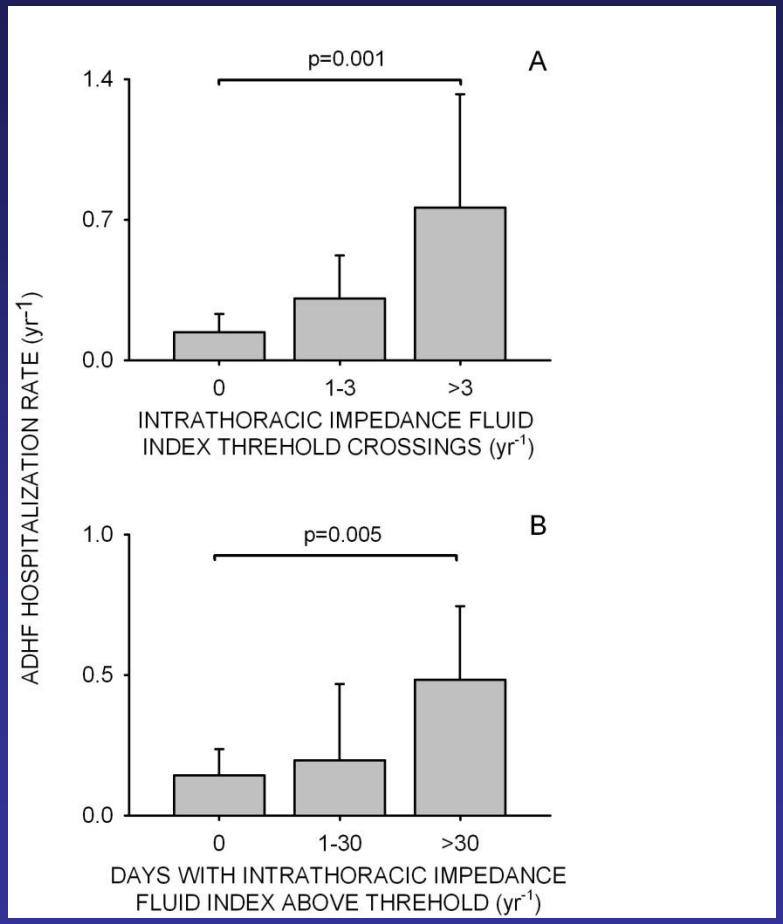
ROY S. SMALL, MD,[1] WILLIAM WICKEMEYER, MD,[2] ROBIN GERMANY, MD,[3] BOBBI HOPPE, MD,[4] JOHN ANDRULLI, DO,[5] PETER A. BRADY, MD,[6] MELODY LABEAU,[7] JODI KOEHLER, MS,[7] SHANTANU SARKAR, PhD,[7] DOUGLAS A HETTRICK, PhD,[7] AND W. H. WILSON TANG, MD, FAHA[8]

Lancaster, Pennsylvania; Des Moines, Iowa; Oklahoma City, Oklahoma; St Paul, Minnesota; Camden, New Jersey; Rochester, Minnesota; Minneapolis, Minnesota; Cleveland, Ohio

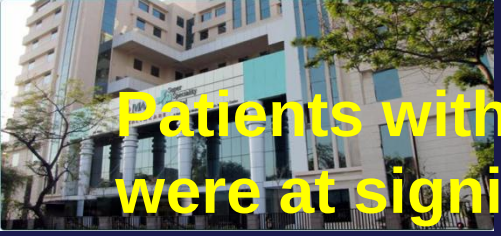
Frequent or sustained OptiVol threshold crossings predicted significantly higher risk of HF hospitalizations. (OPTIMIZE)



- Retrospective multicenter study
- 326 patients tracked over 1 year, pooled among seven clinics

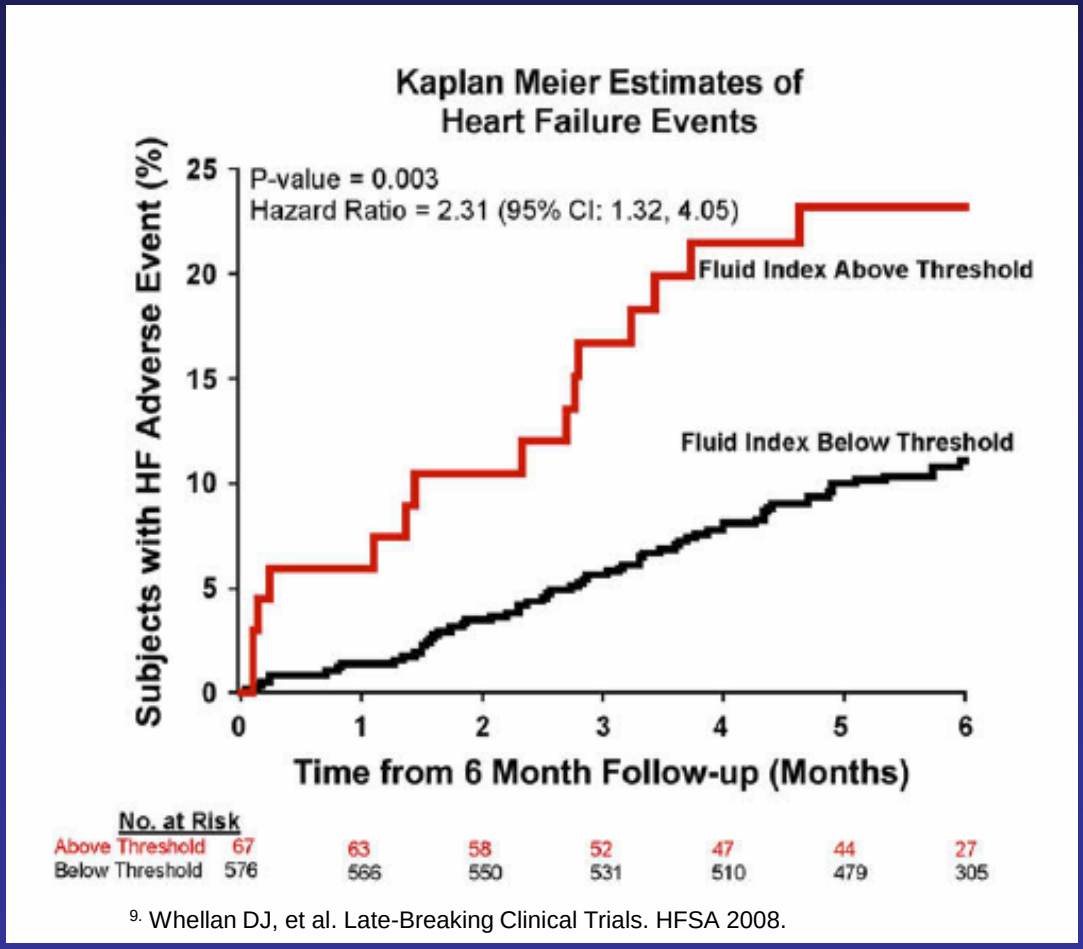


[8.] Small R, et al. *J Card Fail*. In press.



Patients with an OptiVol Fluid Index above threshold were at significantly higher risk of an HF event.

(PARTNERS-HF)



[9.] Whellan DJ, et al. Late-Breaking Clinical Trials. HFSA 2008.

Unadjusted Kaplan-Meier estimates

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Weights alone are good enough

Weights alone are good enough

- Don’t discount weight changes
- Its not about which is better; OptiVol and weights are **both** signs of worsening HF **and** compliment each other.

Weights alone are good enough

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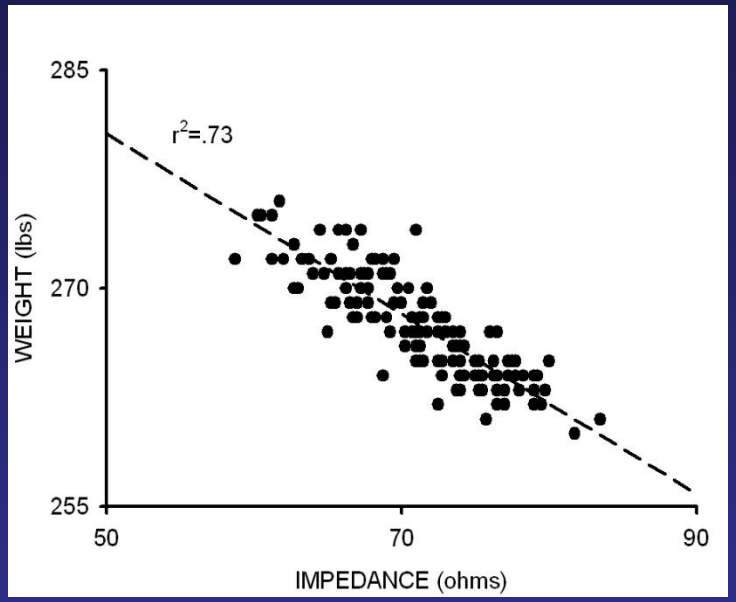
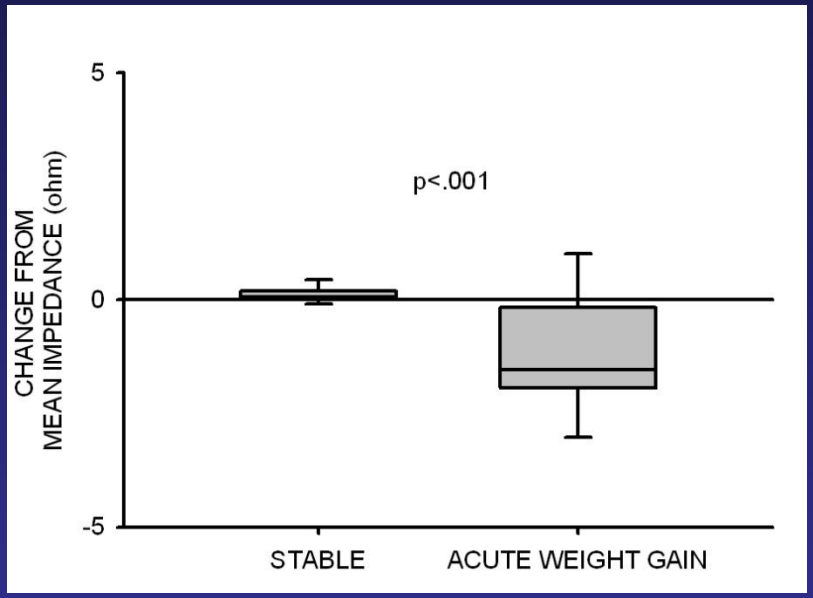
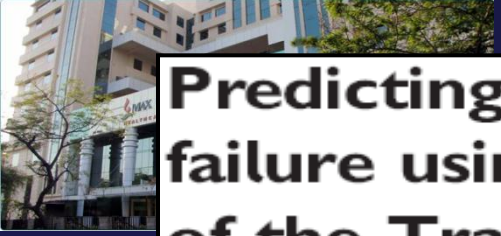
OptiVol and Weight: IMPEDE HF Study





- **Weight and Impedance are inversely correlated**
- **Acute weight gains of 3 lbs are more w/in a week were associated with a significant drop in impedance.**

Andriulli et al., *J card Fail*, 2008;14:6S.



Predicting hospitalization due to worsening heart failure using daily weight measurement: analysis of the Trans-European Network-Home-Care Management System (TEN-HMS) study[1]

- The data for this study were collected as part of the Trans-European Network-Home-Care Management System (TEN-HMS) study.[2]
- **Primary Objective:** Predict worsening HF hospitalizations in the 14 days prior to the event
- 3 algorithms tested:
  - 3lbs/day,
  - 5lbs./3days,
  - "MACD": moving average convergence/divergence

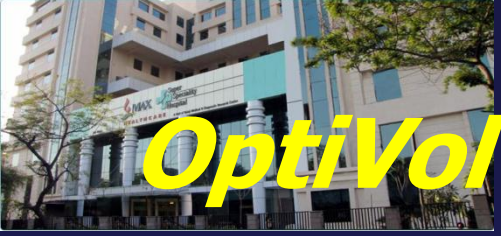
1. European Journal of Heart Failure (2009) 11, 420–427
2. J Am Coll. Cardiol... 2005;45:1654–1664.

Myth #5: Weights alone are good enough

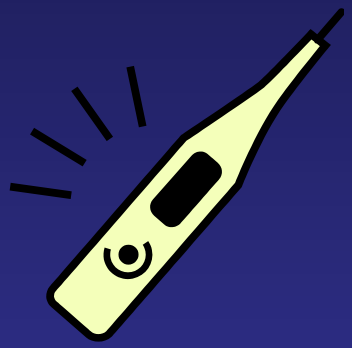
IF YOU TAKE ISSUE WITH OPTIVOL, DON'T TELL US WEIGHTS ALONE ARE BETTER!!

Figure 1 Example of a patient's weight measurement, symptom changes, and alerts produced by the moving average convergence divergence (MACD) and rule-of-thumb (RoT) algorithms prior to a hospitalization due to worsening heart failure (H).

- Only 20% of patients have weight gain in the period prior before a WHF hospitalization or episode of worsening HF.
- "Acute pulmonary edema can occur in the absence of weight gain"
- "Lack of weight gain does not exclude the presence of worsening HF"
- "It may be that weight alone is not sensitive or specific enough to detect episodes of worsening HF

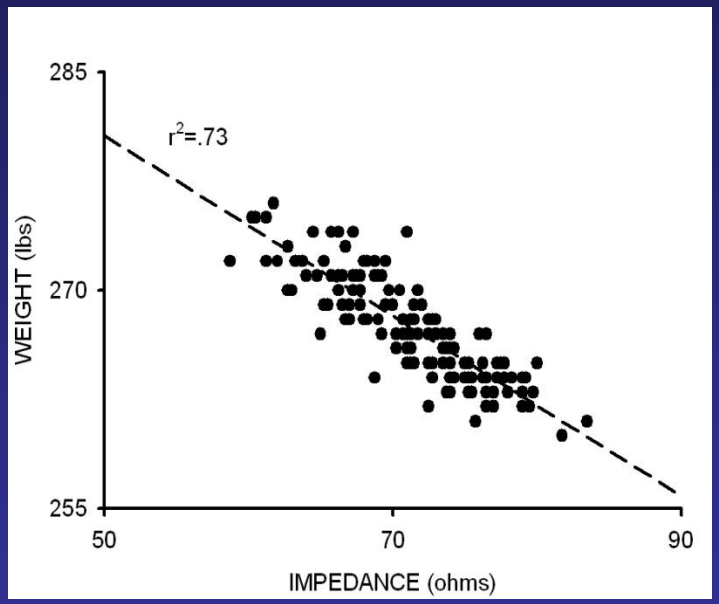


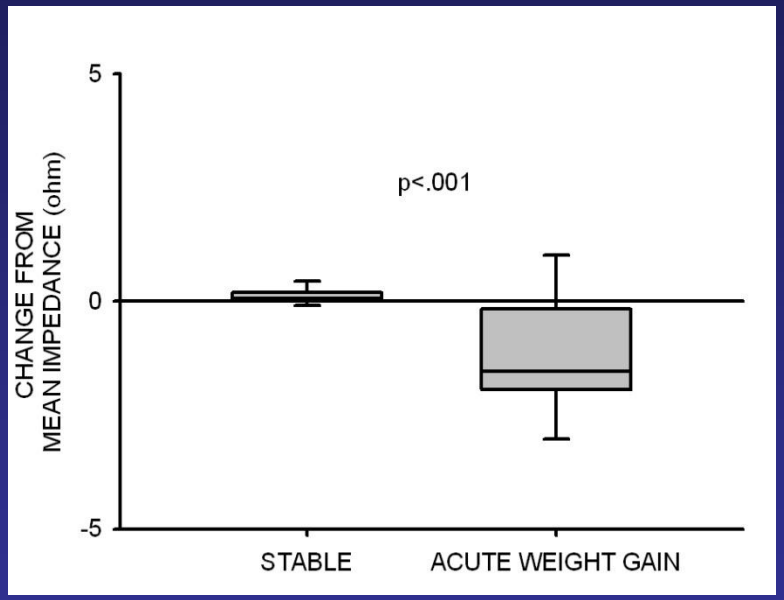
OptiVol versus Weight versus BNP



OptiVol and Weight:

IMPEDE HF Study





[17] Andriulli J, et al. *J Card Fail*. 2008;14:6S.

FAST TRIAL

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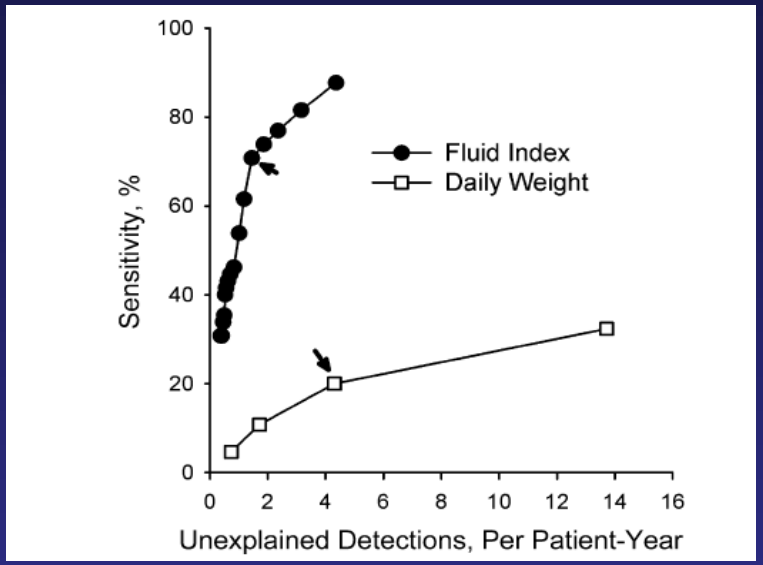
Acuracy of Fliud Index vs. Daily Weight measurement



	Fluid Index[a]	Weight[b]	P Value
Sensitivity, %	76.4 (60.8–87.1)	22.5 (12.5–37.1)	<.0001
Unexplained detection rate, per patient-year	1.9 (1.7–2.1)	4.3 (3.2–5.8)	<.0001

OptiVol and BNP

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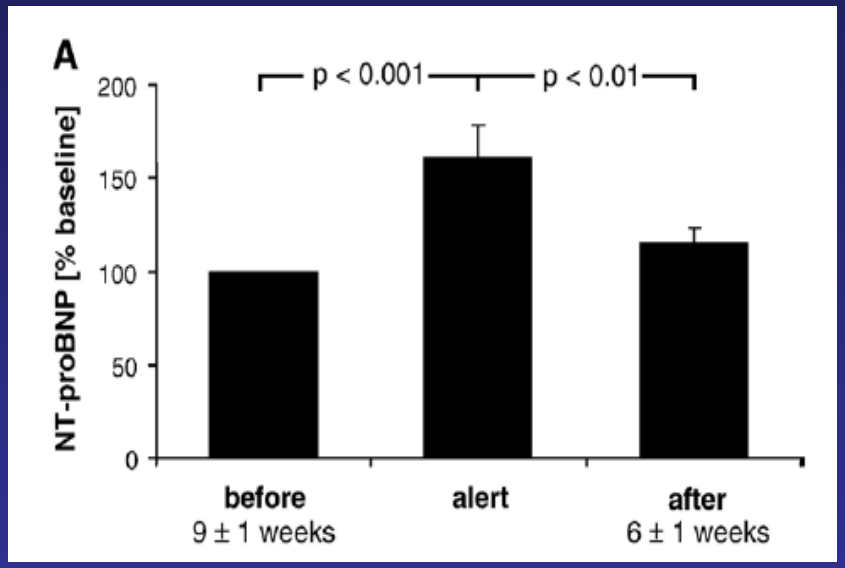
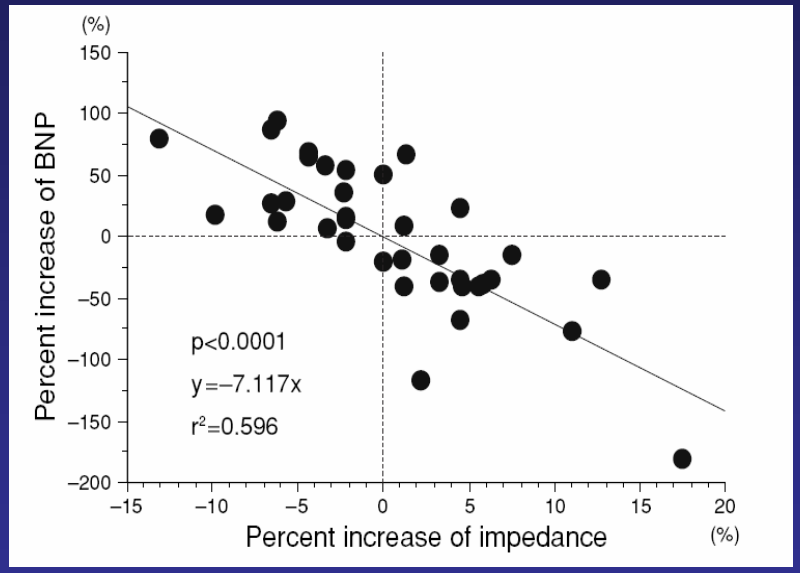
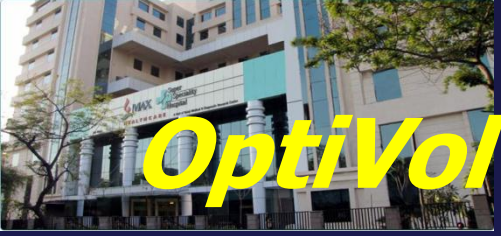
Association between Impedance and BNP





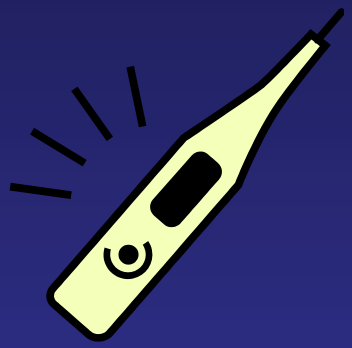
[15.] Lüthje L, et al. *Eur J Heart Fail*. 2007;9:716-722..

[16.] Matsushita K, et al. *Circ J*. 2006;70:1462-1465.



OptiVol versus Weight versus BNP

- It's NOT a contest



- BNP is a useful clinical tool
- **OptiVol is a useful clinical tool**
- Weight is a useful clinical tool