



TEN YEARS' EXPERIENCE WITH REMOTE MONITORING IN HEART FAILURE

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BACKGROUND

Ten years ago this journal published a report about the emerging technology of physiologic monitoring of intra-thoracic impedance to assess fluid congestion in heart failure patients.¹ A decade later, the quest for efficient and effective care of the chronic heart failure population remains a substantial and expanding enigma, and it is appropriate to reassess this technology and its current role in the chronic management of these patients. It's a tale of scientific promise, logistical barriers, industry inertia, and payment reform, and perhaps an instructive paradigm for the introduction of other new medical technologies.

FINANCIAL IMPLICATIONS

Heart failure-related medical management remains the largest single item in the Medicare budget (> \$25 billion/year),² complicated by staggering hospital readmission rates (> 25%, 30 day all cause).³ Continued aging of the population and expansion of treatment options will assure that this diagnosis remains a focus of the cardiology community and payers for the foreseeable future.

Recognizing this liability, and capitalizing on the realignment between hospitals and medical practices in the past several years, the Center for Medicare Services (CMS) has instituted financial incentives (or rather disincentives) for the management of this population. In 2015, hospitals that fail to achieve target readmission rates adjusted for "disease severity" will be assessed up to a 3% yearly penalty on all Medicare payments. To a mid-sized community hospital such as Lancaster General (LGH), this would be >\$3,000,000/yr. if the maximal penalty were imposed. To date, LGH is among the ~20% of hospitals that have not received any penalties for heart failure management since this incentive was first introduced 3 years ago.

PHYSIOLOGY

The scientific principle underlying the measurement of impedance, which is the biologic equivalent

of resistance, is Ohm's law: $R=V/I$. Resistance (R) is a function of the relationship between the applied voltage (V) and the current (I) measured across an electrical field. In patients with an implanted defibrillator/pacemaker/resynchronization device that can measure impedance, the electric field includes the lung and thoracic tissue that lie between the device and the tip of the pacing electrode ("wire"). A "congested" chest has higher fluid content and a lower resistance (or impedance), as "water" is a better conductor than air. In keeping with current pacemaker technology, these devices can be interrogated either in person or remotely, and along with time-aligned detection of pacing, activity, and rhythm, can be a useful adjunct in patient management.

CLINICAL IMPLICATIONS

Numerous reports have confirmed that changes in device-monitored physiologic parameters (specifically impedance) can predict patient outcomes regarding re-hospitalization,^{4,5} decompensation,⁶ and mortality.^{7,8} It has been much harder to prove that proactive monitoring of devices can change outcomes. Unlike a drug or the device itself, a diagnostic tool does not change outcome by itself, but relies on interpretation, communication, and patient compliance to effect change.

Medtronic marketed the first impedance-monitoring device over 10 years ago. Although initially derided by competitors, all 3 major manufacturers have subsequently adopted impedance monitoring in their devices. For its part, Medtronic was initially either unwilling or unable to facilitate the system development required to capitalize on this technology. The absence of industrial financing and lack of professional/technical reimbursement (subsequently corrected) conspired to impede its adoption. Furthermore, the infrastructure required to effectively implement this technology required significant capital investment on the part of private practices. Only recently have payment reform and practice realignment encouraged this type of investment.

The adoption of physiologic monitoring of devices has been commonplace but not ubiquitous. In part this is related to the absence of “proof” of clinical effectiveness. But a more significant barrier has been the knowledge gap of providers who often have limited exposure to these devices because of the lack of a consistent approach to this population. When severe heart failure patients are randomly distributed throughout a practice (either cardiology or primary provider) rather than concentrated in a specific setting (a “heart failure clinic”), sufficient clinical experience is difficult to acquire. Furthermore, the logistical systems required to manage this information (let alone the billing issues) when heart failure care is decentralized in a practice can be overwhelming.

CLINICAL EXPERIENCE

The Heart Group of Lancaster General Health was one of the first non-academic practices in the nation to organize a heart failure clinic for the management of severe (NYHA Class III-IV) heart failure patients. We currently follow >2,000 patients of

whom >1,000 have implanted devices. The concentration of these patients in a specialized clinical setting allowed us to develop the expertise and logistics to utilize physiologic monitoring for meaningful patient management. In a small, retrospective, uncontrolled analysis of our clinic population, we found that physiologic monitoring was associated with improved outcomes.⁹ Lancaster General Hospital has consistently had one of the lowest hospital readmission rates for heart failure in the nation.¹⁰

WHAT'S NEXT?

In the future we hope to have more monitors on more platforms, as the heart failure population continues to grow and to bedevil providers and payers. New and multiple sensors will improve diagnostic specificity while a commitment to infrastructure will facilitate utilization. Payment reform will incentivize novel clinical management tools while private industry will push the technological envelope. Ultimately, this utopian vision would predict improved quality and decreased cost of medical care. But we’ll check back in ten years . . .

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