

# **Remote Monitoring**

## Advancing the Science of Health Care Delivery

Charles J. Bruce, MD



# Disclosure

- Mayo Clinic and Dr. Bruce have a financial interest in the technology referenced in this presentation

# Vision: Home Monitoring

- Develop **integrated adaptable** system
- **“Dashboard”** overall health/well-being
  - Screening
  - Prevention
  - Management
- Lengthen **independence**



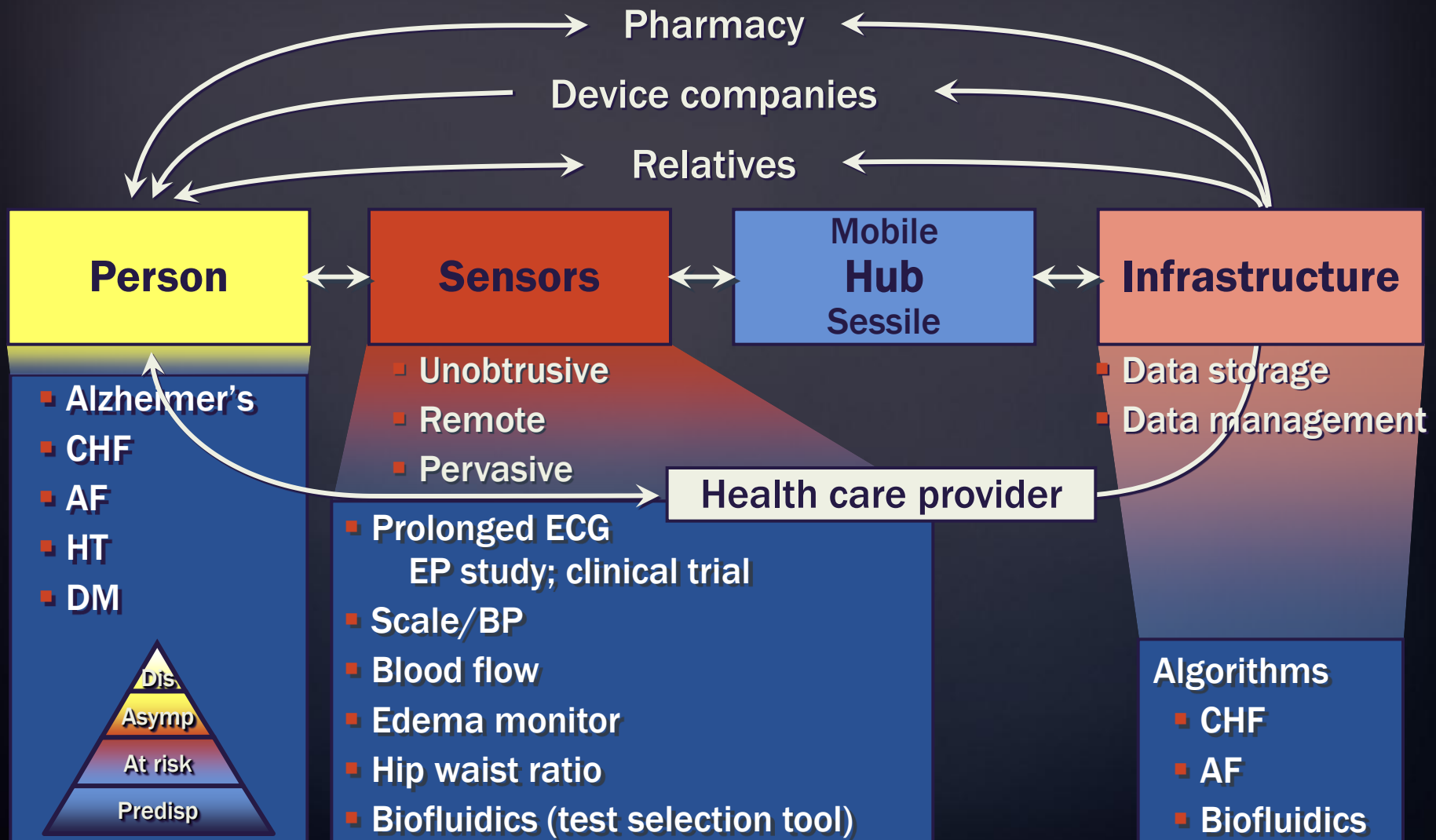
# Mayo Clinic Facts: Patient Care 2011

■ Unique patients	1,113,000
■ Hospital admissions	123,000
■ Hospital days of patient care	588,000
■ Personnel	56,077
■ Total revenue (millions)	8,475

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# Intelligent medical cabinet





# Our Approach

- Long-term, unobtrusive monitoring to promote mobility and independence
- Focus on emerging epidemics
  - Atrial fibrillation
  - Congestive heart failure
  - Obstructive sleep apnea
- Integration of physiological signals
- Ensure system non-proprietary, adaptable, integrated

# Remote Monitoring Platform

## CHF Monitor “Proof of Concept”

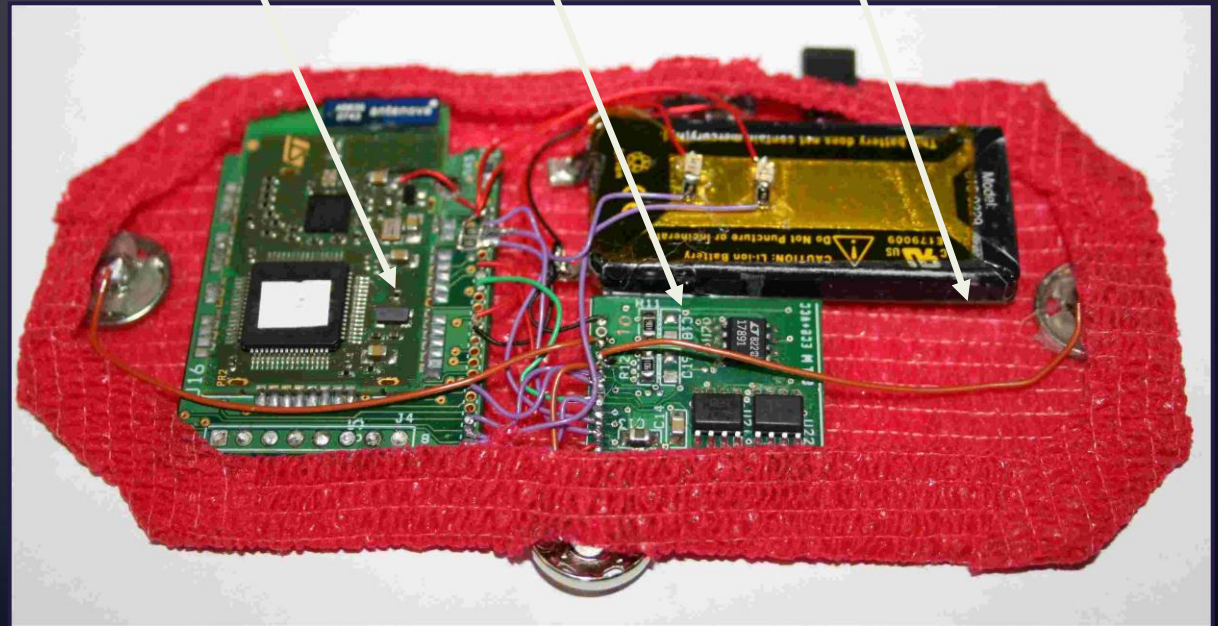
- ECG
- Activity
- Breathing
- Scale
- BP
- Diagnostic/treatment algorithm



# Initial Band-Aid Prototype

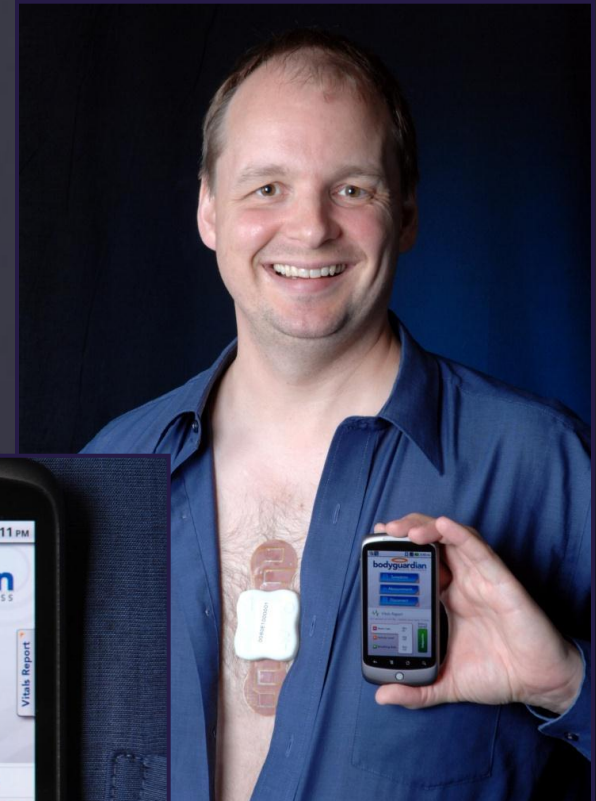


STM32+BT    ECG+ACC    Battery (18 grams)



27 grams

# Personal Wireless Health Monitor





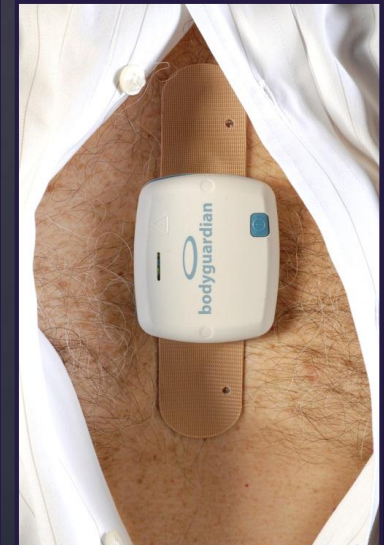
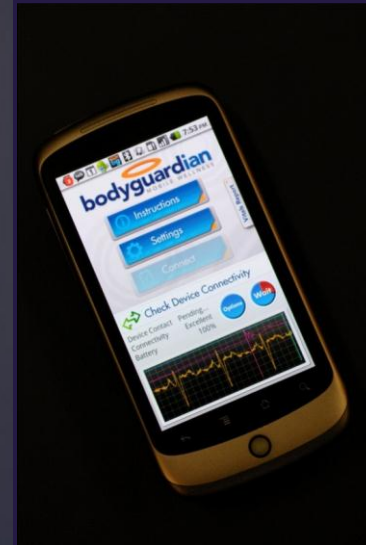
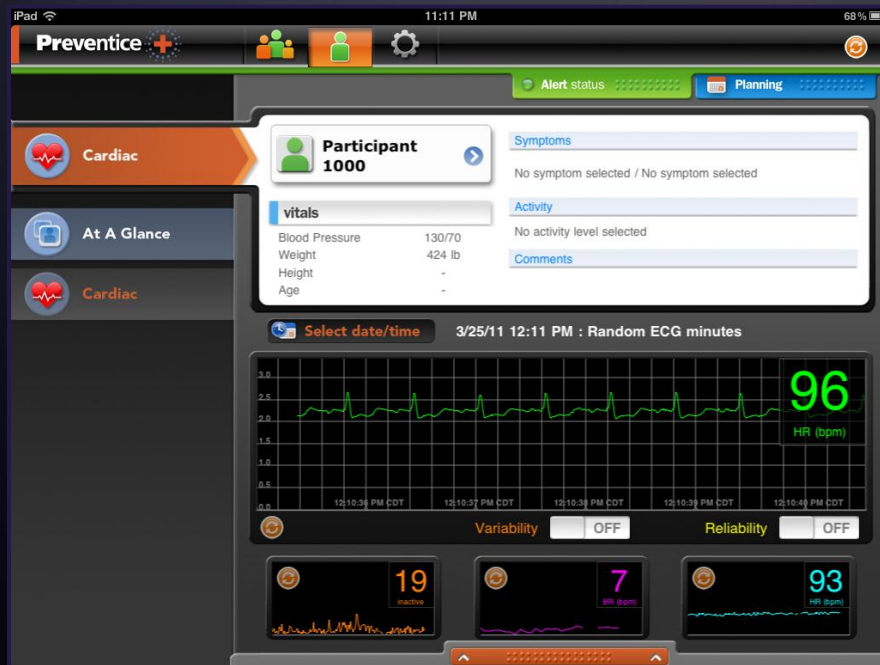
# Remote Patient Monitoring

ECG

Respiratory

Body position

Physical activity



## PATIENT LIST

View Patient Profile

Refresh List

Data was last refreshed at 1:12 PM CDT.

Filter: All Events

## ECG Event Calendar (All Events)

Export

April 2013						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	<div>  31   1   23                 </div>	<div>  28   22                 </div>	<div>  32   20                 </div>	<div>  14   23                 </div>	<div>  6   24                 </div>	<div>  23   24                 </div>
<div>  18   23                 </div>	<div>  1   21                 </div>	<div>  6   14                 </div>	<div>  34   2   22                 </div>	<div>  12   23                 </div>	<div>  12   1   23                 </div>	<div>  7   23                 </div>
<div>  20   1   23                 </div>	<div>  26   22                 </div>	<div>  12   16                 </div>	<div>  22   4   23                 </div>	<div>  13   24                 </div>	<div>  23                 </div>	<div>  7   23                 </div>
<div>  5   23                 </div>	<div>  24                 </div>	<div>  7   23                 </div>	<div>  7   24                 </div>	<div>  19   23                 </div>	<div>  24                 </div>	<div>  10   23                 </div>
<div>  18   22                 </div>	<div>  4   24                 </div>	<div>  23                 </div>				

### View a Specific Time

Hr: 12 Min: 00 Sec: 00 AM/PM: AM

### Sort Events for 4/1/2013

By Type

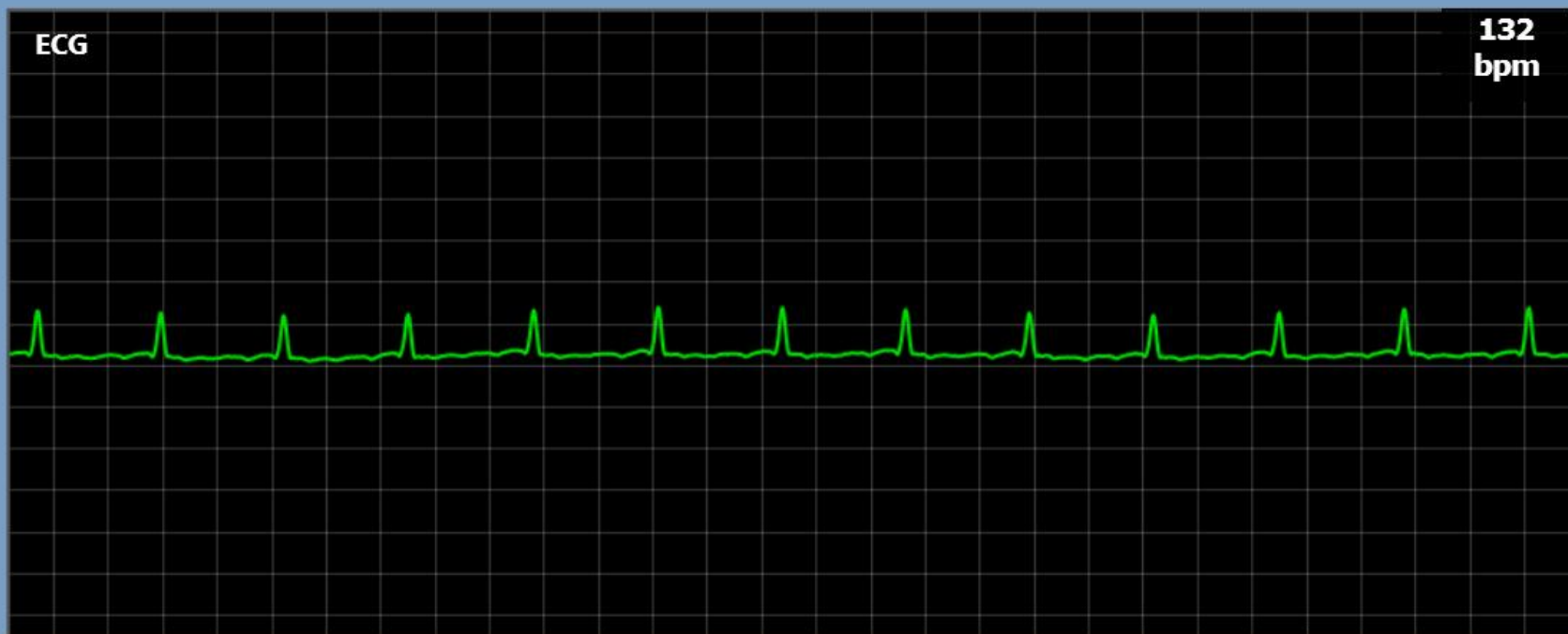
By Time

### April 1, 2013

- Threshold Event
- Button Push
- Baseline Sample
- Monitoring Log

ECG

132  
bpm



08:09:59 PM

08:10:00 PM

08:10:01 PM

08:10:02 PM

08:10:03 PM

08:10:04 PM



Reset

Export

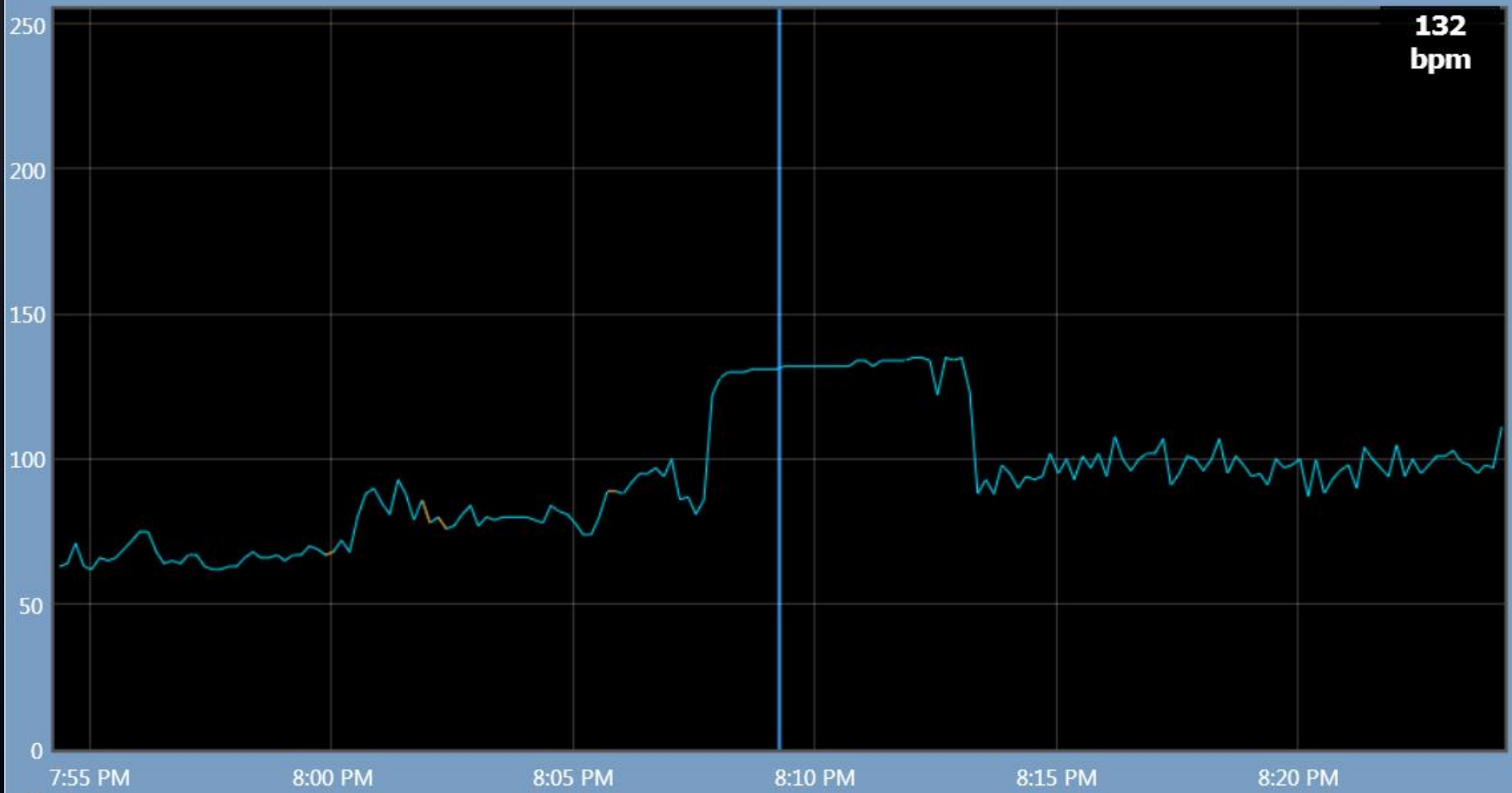
Rx Details

### Threshold Event

Tachycardia (extreme) while Inactive - 4/13/2013 8:09:16 PM CDT

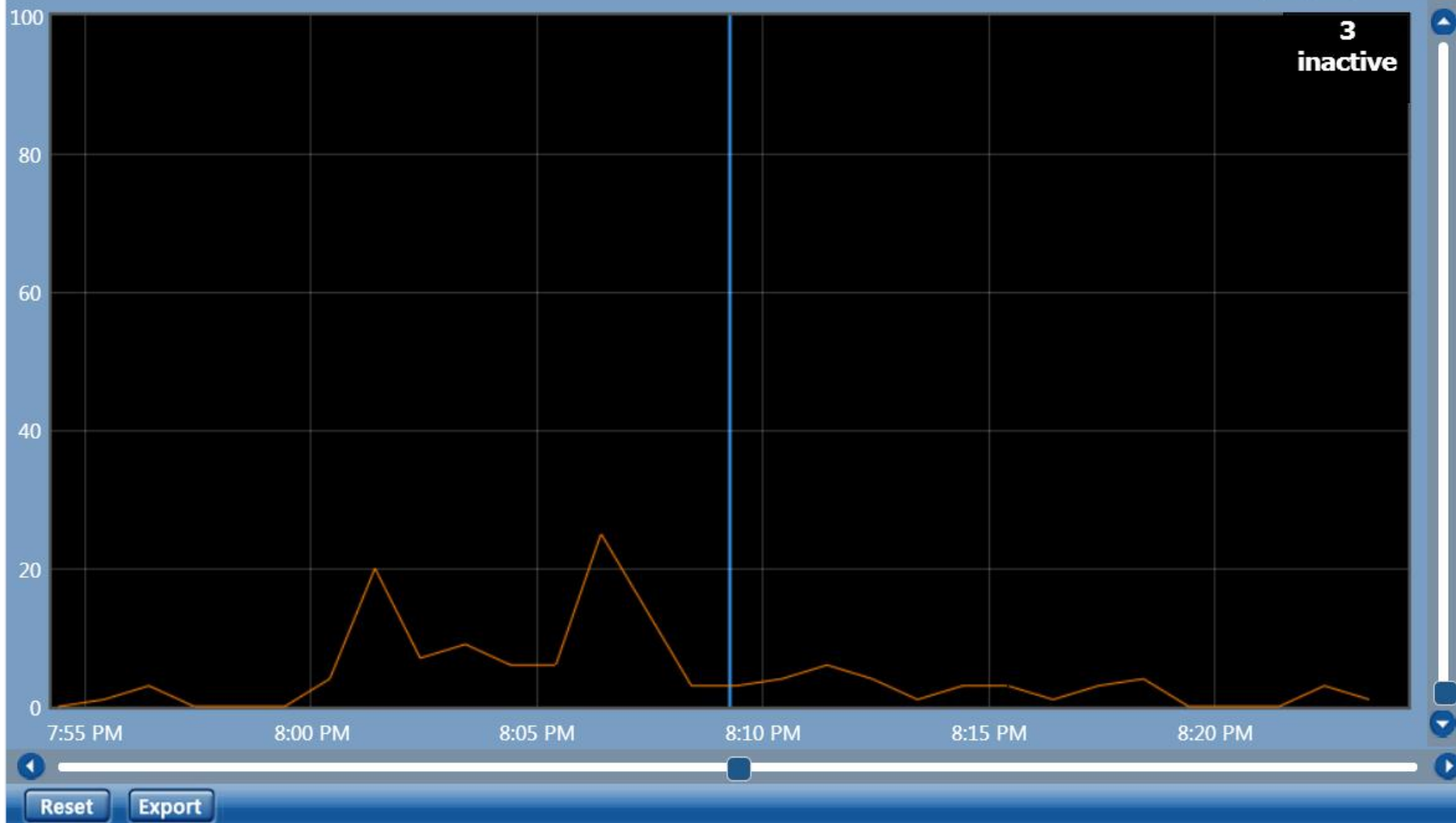
Heart Rate - Tachycardia (extreme) while Inactive - 4/13/2013 8:09:16 PM CDT

Zoom



Reset

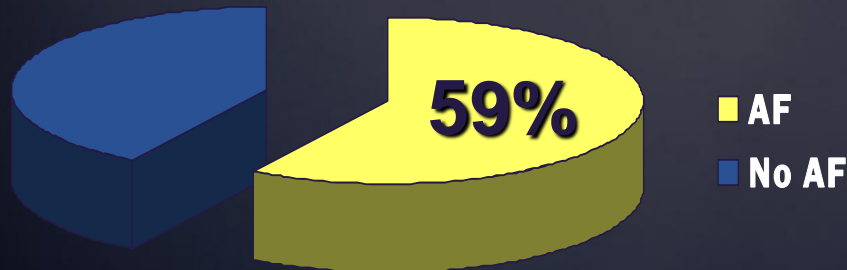
Export





# Remote Monitoring and AF Recurrence

- 27 patients undergoing DCCV or AF ablation
- Monitored for four weeks



Ave time to AF  
recurrence

**11:23:18**

Days : Hours : Minutes

# An Opportunity?

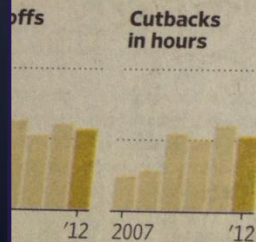
POST-BULLETIN • www.PostBulletin.com

SATURDAY, SEPTEMBER 1, 2012 C5

THE WALL STREET JOURNAL SUNDAY.

## We Can Understand

veyed are still concerned



art-time conducted Aug. 9-12;  
The Wall Street Journal

hfulness might be cost-

the conclusion of a new  
om the Texas Office of  
urance Counsel, which

down home loans while others  
erased their debts and lost their  
homes by completing the foreclo-  
sure process.

—Josh Mitchell  
The Wall Street Journal

### Be a 'Bicultural' Worker

Moving abroad used to be con-  
sidered a surefire way to move up  
the corporate ladder. It's no lon-  
ger that simple.

A new report (to be published  
in the Journal of Personality and  
Social Psychology) suggests that  
merely taking a work assignment  
abroad doesn't do much to im-  
prove creativity or propel em-  
ployees along the path to career  
success.

What does lead to a career  
boost is actively integrating one's  
home culture—values, hobbies,  
world view—with that of the ad-  
opted overseas home, say three

## HEALTH COSTS

### Avoid Rehospitalization

By KRISTEN GERENCHER

Hospitals have a new incen-  
tive to help keep you from boo-  
meranging back to them shortly  
after you've been sent home or  
to another care facility.

Starting in October, general  
hospitals will begin losing a  
portion of their Medicare pay-  
ments if too many patients are  
readmitted within 30 days of  
being discharged for pneumo-  
nia, heart failure or heart at-  
tack, according to a provision in  
the health-care law.

More than 2,200 hospitals  
are affected this year. Medicare  
payments to hospitals will be  
reduced by 0.3%, or nearly \$300  
million, says Nancy Foster, vice  
president for quality and pa-  
tient-safety policy for the  
American Hospital Association,  
a trade group in Washington.

and set goals for your hospital  
stay, says Sandra Thompson,  
administrator of quality and  
compliance for the Laurens  
County Health Care System.

◆ **Understand your dis-  
charge plan.** At discharge, go  
over your care plan with some-  
one who can correct you if you  
miss or confuse something—es-  
pecially if you're changing med-  
ications or facing new dietary  
restrictions. Get help if the lan-  
guage is unclear or riddled with  
acronyms. If you have any pend-  
ing test results, ask to have that  
documented in your discharge  
record so the results aren't for-  
gotten at your follow-up visit.

◆ **Ask for help.** Alert the dis-  
charge planner if you can't af-  
ford your medications or can't  
get transportation to the doc-  
tor's office. The hospital should  
be able to help you access drug

# Heart Failure USA – Scope of Problem

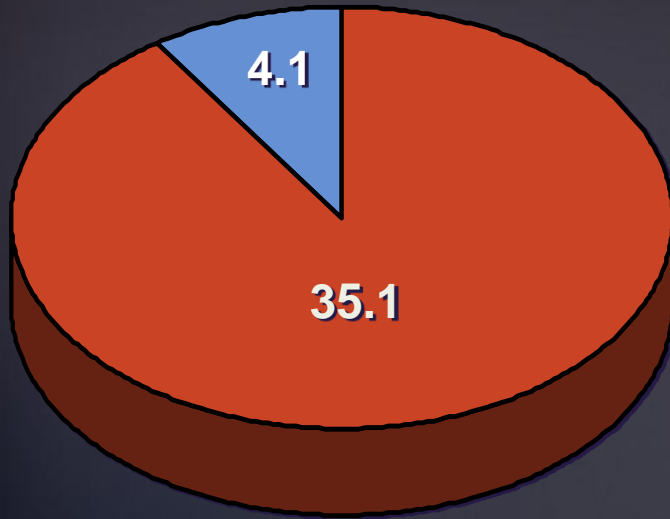
## Demographics of an Epidemic

<b>Prevalence:</b>	>6.6 million over age 18 (2.8%) ~9.5 million by 2030 (3.5%)
<b>Incidence:</b>	>680,000 new cases/year
<b>Mortality:</b>	~57,000 deaths 2008; more than all cancer combined
<b>Morbidity:</b>	Most common discharge diagnosis in patients >65 years; 12M annual office visits
<b>Lifetime risk:</b>	1 in 5 after age 40

Roger V., et al: AHA Heart and Stroke Statistics. Circ 2012  
Heidenreich P, et al: Circ 2011

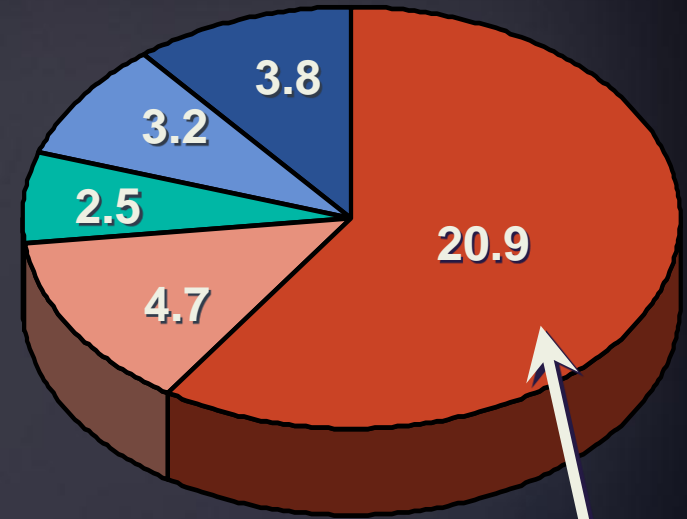
# Cost of CHF

Total cost 39.2 (\$B)



- Direct expense
- Indirect expense (excluding morbidity)

Expenditures (\$B)



- Hospital cost
- Nursing home
- Physician
- Drugs, etc
- Home health

Prevalence (2006)	50,800,000
Incidence (2006)	670,000
Mortality (2006)	282,754
Hospital discharges (2006)	1106,000

# **U.S. Government Response**

## **CMS – HF Outcome Quality Measures**

- 30-day HF mortality and re-admission rates are **publicly reported**
- 30-day HF re-admissions **will be linked to reimbursement**



# Impact Home Monitoring on HF Outcomes

## Meta-Analysis – 27 Studies (n=8,323)

Endpoint	Intervention	Control	RR (95% CI)	P
All-cause mortality				
Telephone	112	127	0.88 (0.76-1.01)	0.08
Telemonitor	102	154	0.66 (0.54-0.81)	<0.0001
HF hospitalization				
Telephone	164	213	0.77 (0.68-0.87)	<0.0001
Telemonitor	225	285	0.79 (0.67-0.94)	0.008
All-cause hospitalization				
Telephone	379	412	0.92 (0.85-0.99)	0.02
Telemonitor	474	521	0.91 (0.84-.99)	0.02

Konstam M., Circ 2012

Inglis SC, et al: Cochrane Database 2010

# Telemonitoring to Improve HF Outcomes (Tele-HF)

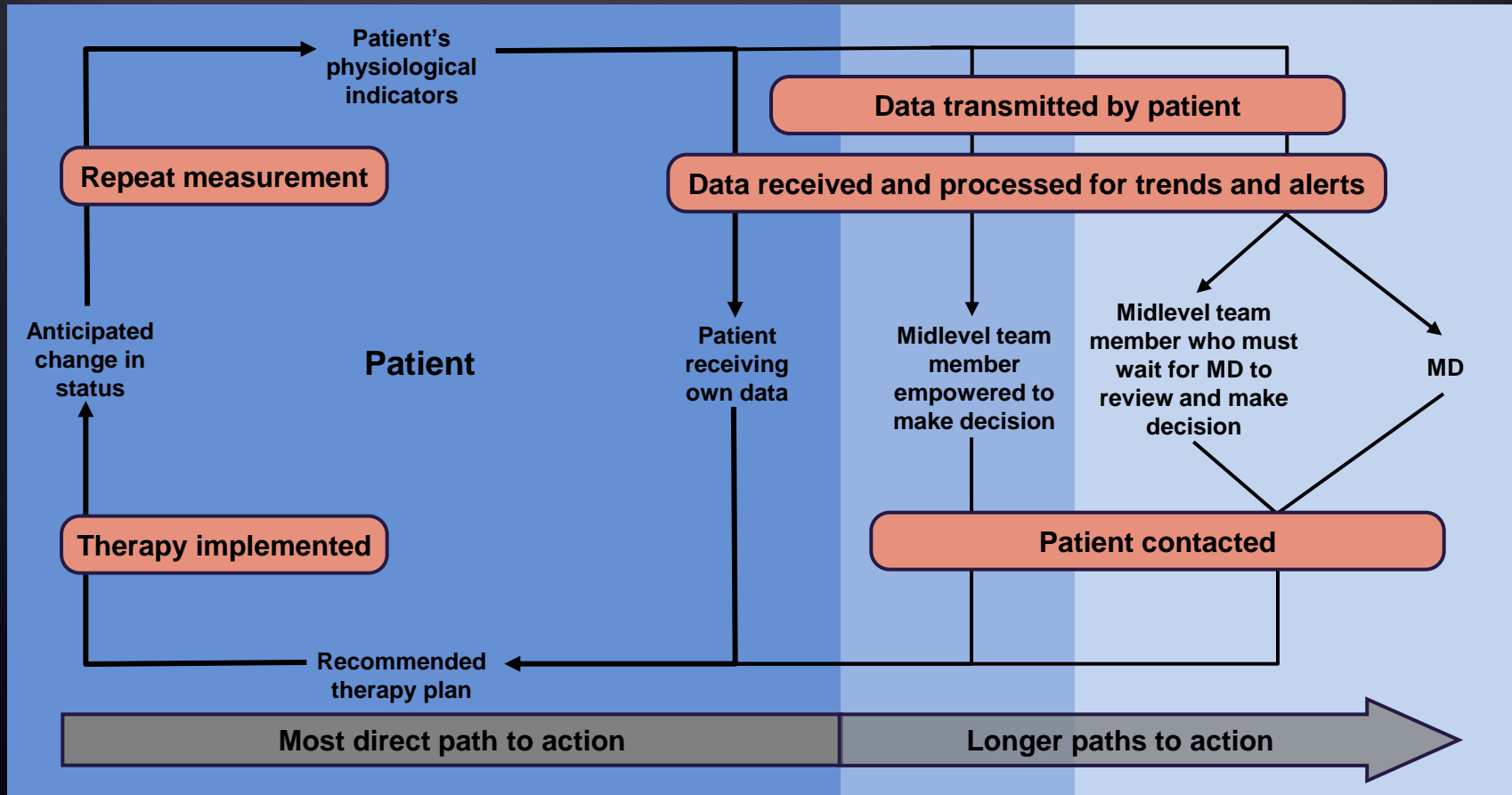
## Randomized Controlled Trial

- Does telemonitoring reduce combined endpoint of **re-admission or death from any cause?**
- Multi-center RCT 1653 pts recently hospitalized for HF; 6 month f/u
- Telemonitoring using commercially available system, automated questions – responses entered via keypad
- **No difference** re-admission rates - 49% at 6 months
- **No difference** mortality rates - 11% at 6 months

Chaudhry SI, et al. NEJM 2010



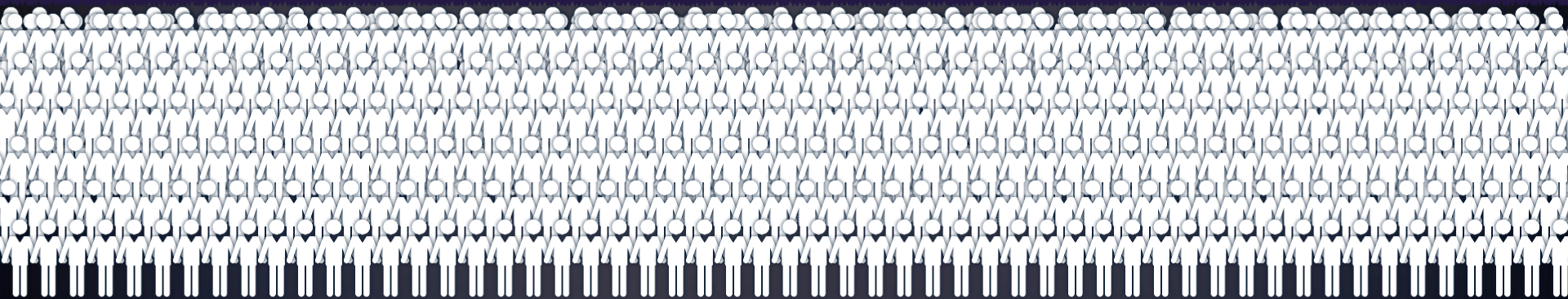
# Circle of Home Heart Failure Management



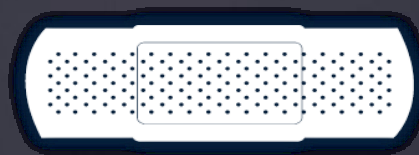
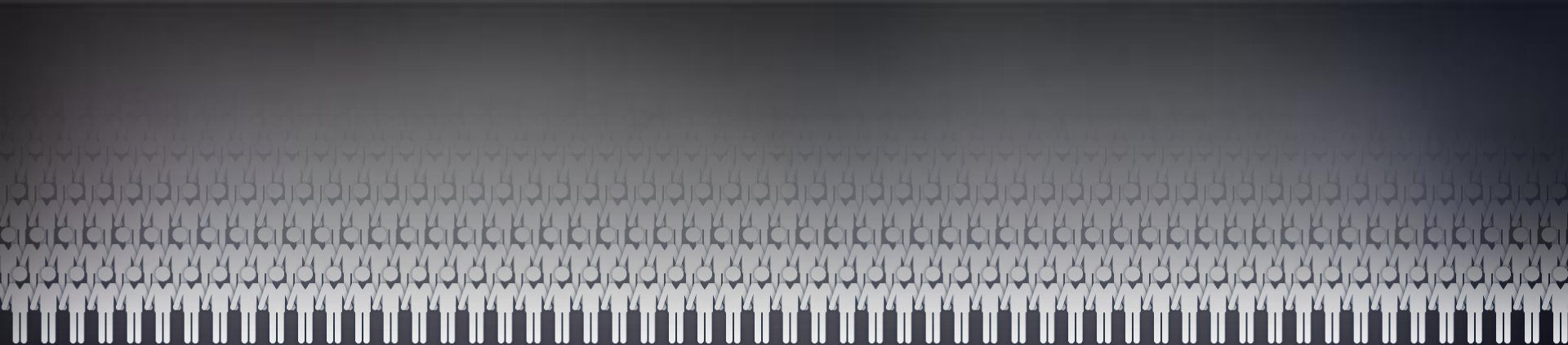
Desai, Stevenson: NEJM 2010

# Opportunities

- Creation of framework for delivering appropriate and timely care
- Proposed model - dedicated tele-medical center that operates 24/7
- Practice integration
- Improve outcomes
- Cost savings



# Primary Prevention Guidelines



**Prevent-aid**

# A Real Multidisciplinary Team Effort

- Kevin Bennet, Paul Friedman and Virend Somers
- Revelie Kaplan, her team and the 4D nurses
- Peter Brady, Doug Beinborn, Ron Menaker
- Pat Roth, Susan Mikell
- Christian Milaster and Tom Halverson
- Brian Striemer, Jan Bukartyk, Christelle van der Walt, Diane Davison
- Sean Caples, John Dillon, Amy Williams, Michael Ackerman, Sam Asirvatham, Yehu Sepir, Amir Geva and Dan Sadot
- Kristin Vickers Douglas, Rickey Carter, Kent Bailey, David Hodge
- Nick LaRusso and the CFI team
- John Abenstein and Michael Kehoe
- Michael Troska and Barbara Baasch
- Andy Danielsen and Tim Argo
- Christian Milaster and Tom Halverson
- DeJae Ladewig
- Chet Rihal