



# CPS and Healthcare

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# Outline

- Short overview on Medtronic, and the Medical space we operate in.
- Examples of CPS in Mainstream Product
- A Progression of CPS in Medical Devices
  - Hardware
  - Implanted
  - Beyond the body
- The Future
  - Opportunity & Challenges

# Improving Healthcare

“Across the world, we are in a continuous quest to improve healthcare. People everywhere want better outcomes, fewer errors, quicker recoveries, and fewer side effects. We’re developing medical technology solutions that not only improve healthcare, but do so while delivering better economic value.”

| **OMAR ISHRAK**, Chief Executive Officer



# Serving the World's Major Geographies



Countries 120+ | Locations 300+

Our business is on track to served > 800K patients this year



# Diverse Businesses to Treat Many Conditions

## RESTORATIVE THERAPIES GROUP

## CARDIAC AND VASCULAR GROUP



Surgical Technologies ■

Physio-Control ■



CRDM ■



31%

Diabetes ■

7%

8%

Neuromodulation ■

10%

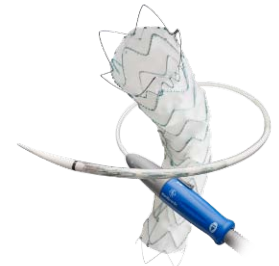


Spinal ■

21%

20%

Cardiovascular ■



Based on FY2011 revenues of \$15.9 billion

# A Broad Platform of Core Technologies

Targeted Drug Delivery

Raw Materials

Power Sources

Miniaturization

Electrical Stimulation

Closed Loop Systems

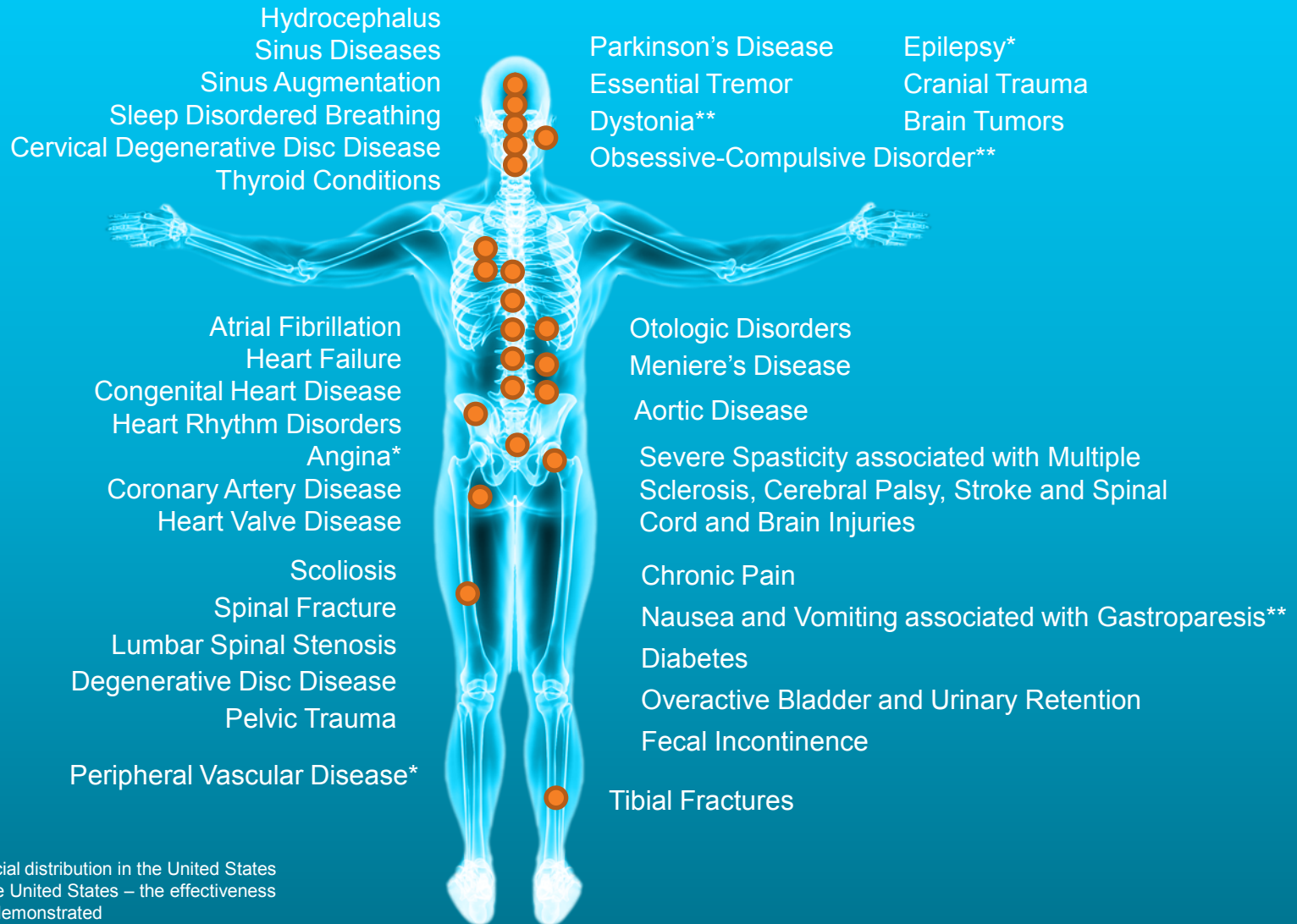
Sensors

Connected Care

Imaging Navigation



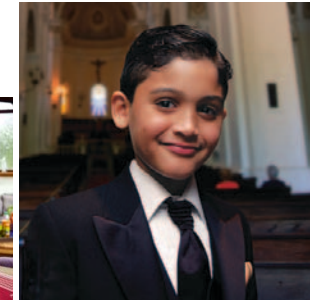
# Therapies to Address Many Chronic Conditions



\* Not approved for commercial distribution in the United States

\*\* Humanitarian Device in the United States – the effectiveness for this use has not been demonstrated

# Improving Another Life Every 4 Seconds



Some common examples of CPS in Medical Devices.

# Cardiac Rhythm Disease Management

*Implanted CPS, communicating to outside clinician*



Atrial fibrillation diagnostics		Insertable heart monitor
Monitoring		Insertable heart monitor
Heart arrhythmia monitoring		Insertable heart monitor
Tachycardia (fast heart rate)		Implantable cardioverter defibrillator (ICD)
Heart failure		Cardiac resynchronization therapy (CRT-D, CRT-P)
Bradycardia (slow heart rate)		Pacemaker
Paroxysmal atrial fibrillation		Cryoballoon cardiac ablation catheter system
Remote heart device monitoring		Internet-based information technology system

For full safety information, visit [medtronic.com](http://medtronic.com)



# Physio-Control

*Non-implanted CPS, communicating real time to clinician and Hospital*

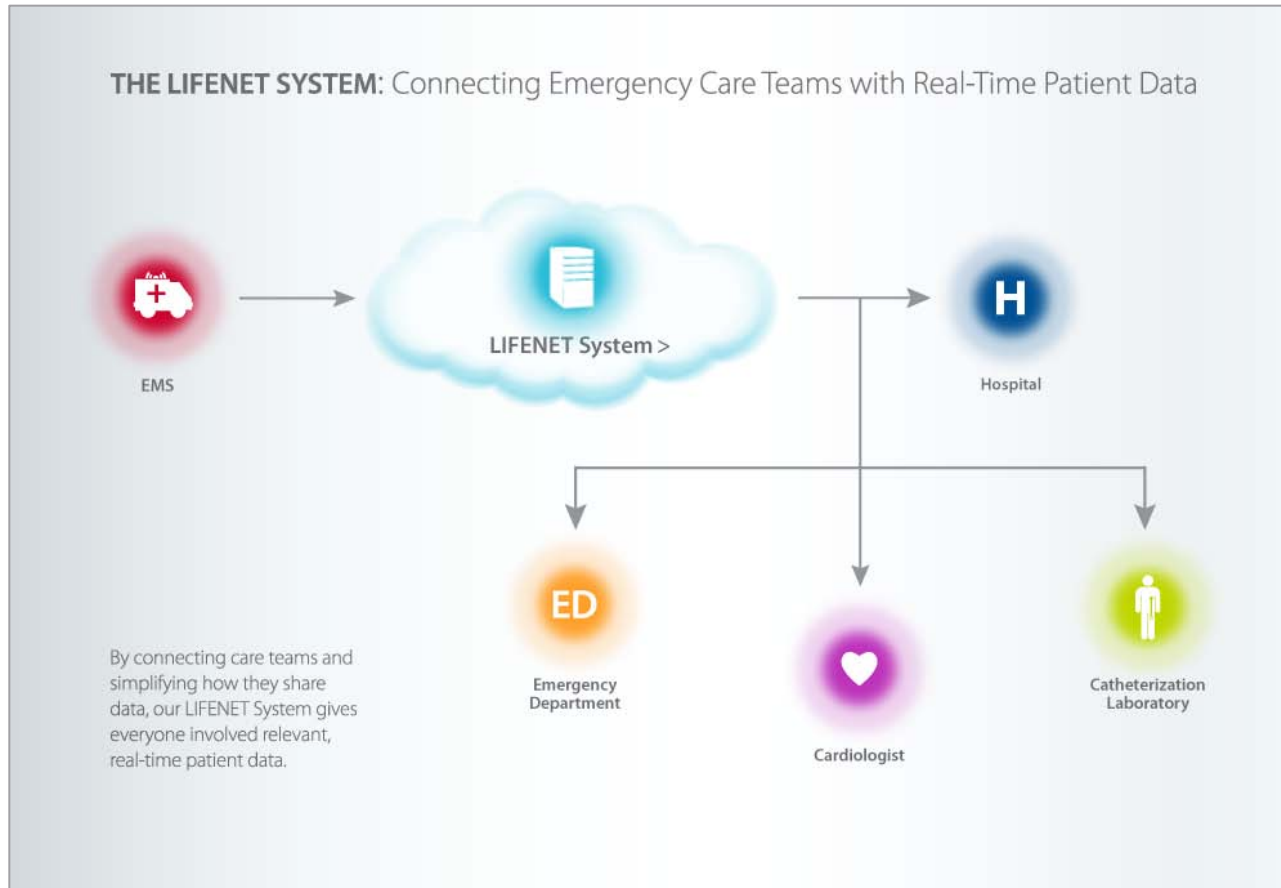


Sudden cardiac arrest and other cardiorespiratory emergencies

- Automated external defibrillators (AEDs)
- Information management system linking emergency medical services (EMS) and hospitals
- CPR assist device

For full safety information, visit [medtronic.com](http://medtronic.com)

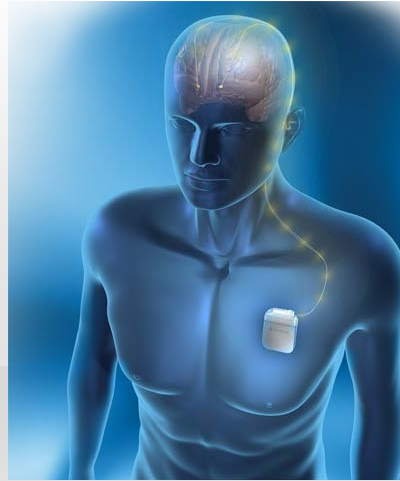
# Speeding and improving Emergency Response



For full safety information, visit [medtronic.com](https://www.medtronic.com)



# Neuromodulation



- |                                |  |   |
|--------------------------------|--|---|
| Movement disorders             |  | Implantable deep brain stimulation systems, drug-infusion systems |
| Obsessive-compulsive disorder* |  | Implantable deep brain stimulation systems                        |
| Chronic pain                   |  | Implantable neurostimulation systems, drug-infusion systems       |

## *Implanted CPS*

\* Humanitarian Device in the United States – the effectiveness for this use has not been demonstrated

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# Neuromodulation



Overactive bladder/urinary retention/chronic fecal incontinence

Nausea and vomiting associated with gastroparesis

Implantable sacral neuromodulation systems

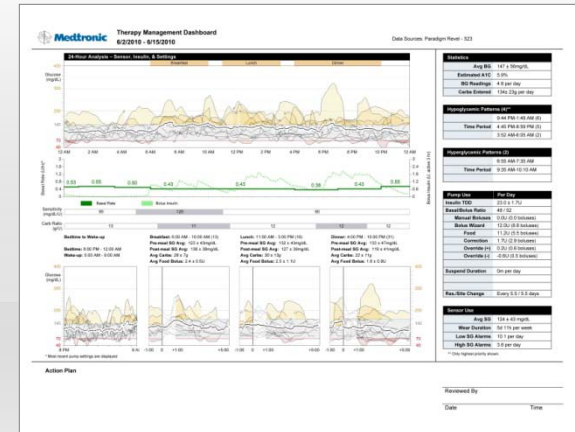
Implantable gastric stimulation systems\*

*Implanted CPS, using patient real time as part of feedback loop*

\* Humanitarian Device in the United States – the effectiveness for this use has not been demonstrated

For full safety information, visit [medtronic.com](http://medtronic.com)

# Diabetes



Insulin delivery

External insulin pumps

Glucose monitoring

Personal and professional continuous glucose monitoring systems

Therapy management software

Online tool that simplifies diabetes management by providing clear insights into personal glucose patterns

*Non-implanted CPS, using patient real time as part of feedback loop, communicating to clinician*

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# CRDM progression of CPS

- 1<sup>st</sup> generation systems were hardware-centric. Matured from “execute a set routine, to prescription based routine, to fully closed loop response systems.”
- 2nd generation evolved to implanted CPS. Wide variety of complexity to manage diversity of physiological conditions. Still primarily a closed loop, in-vivo, system.
- Current generation. Implanted CPS, communicates to a specific non-implanted CPS, which connects to several information networks and in some cases, CPS systems.



# CareLink— Connecting Our Implanted CPS to the World



**1.** Clinic staff can preschedule up to 6 automatic device checks for each patient

**2.** The Medtronic CareLink Monitor is set up within 10 feet of where the patient sleeps. The device automatically “wakes up” at the scheduled time and communicates with the Medtronic CareLink Monitor. Data are transferred automatically as the patient sleeps.

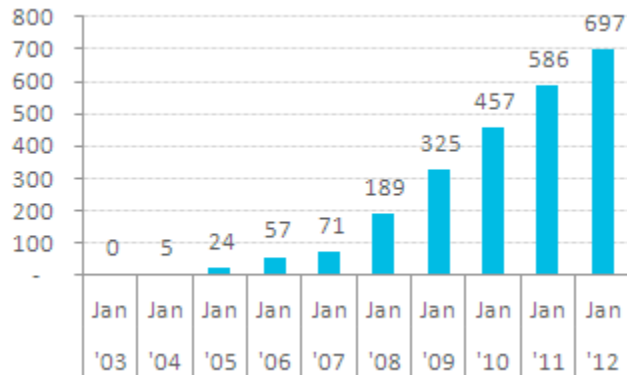
**3.** Data are transferred to a secure server via the patient’s standard phone line.

**4.** The clinician reviews the patient’s device data on the secure website

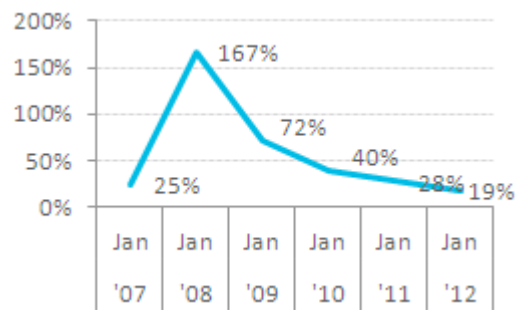
# CareLink Network – FY12'Q3

## Serving Over 6,400 Clinics and 697,000 Patients in 32 Countries

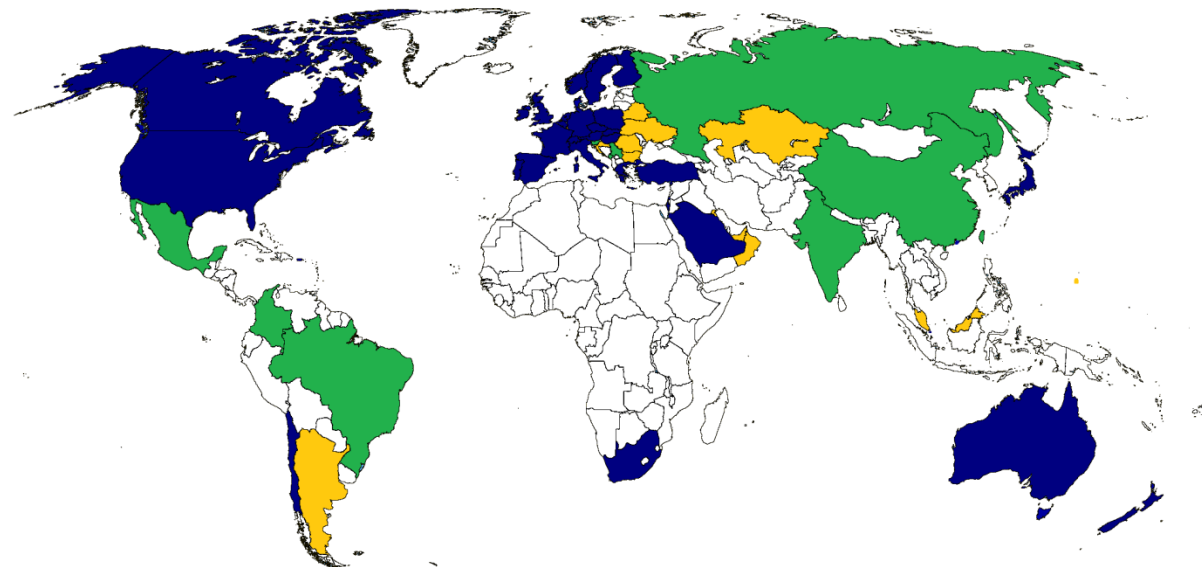
**Global CareLink Patients (thousands)**



**Global CareLink Patients (yoy growth)**



**CareLink Global Presence**



Current Country

In-progress/planned

# The Future

## Opportunity & Challenges



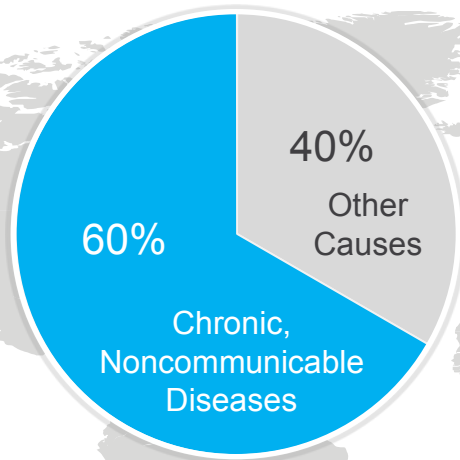
In 2005 **35 million**  
**people** died from  
noncommunicable  
diseases worldwide



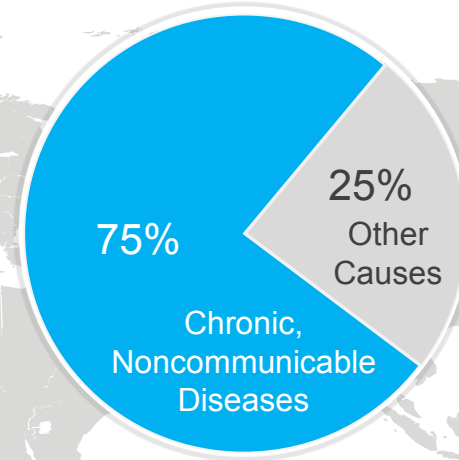


# Chronic Disease Becoming a Global Epidemic

Number 1 Cause  
of Death



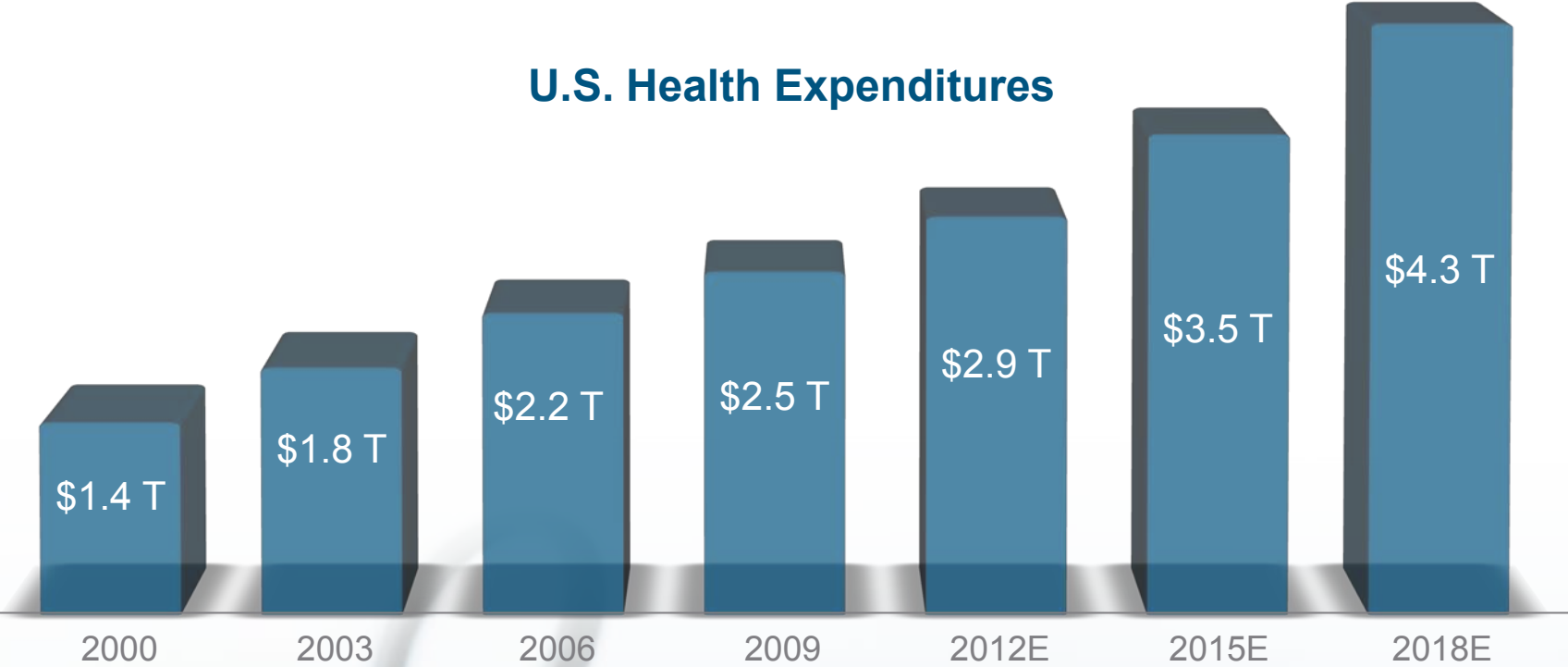
Accounts for Majority of  
HealthCare Costs



Source: U.S. Census Bureau, International Data Base (IDB), June 2011

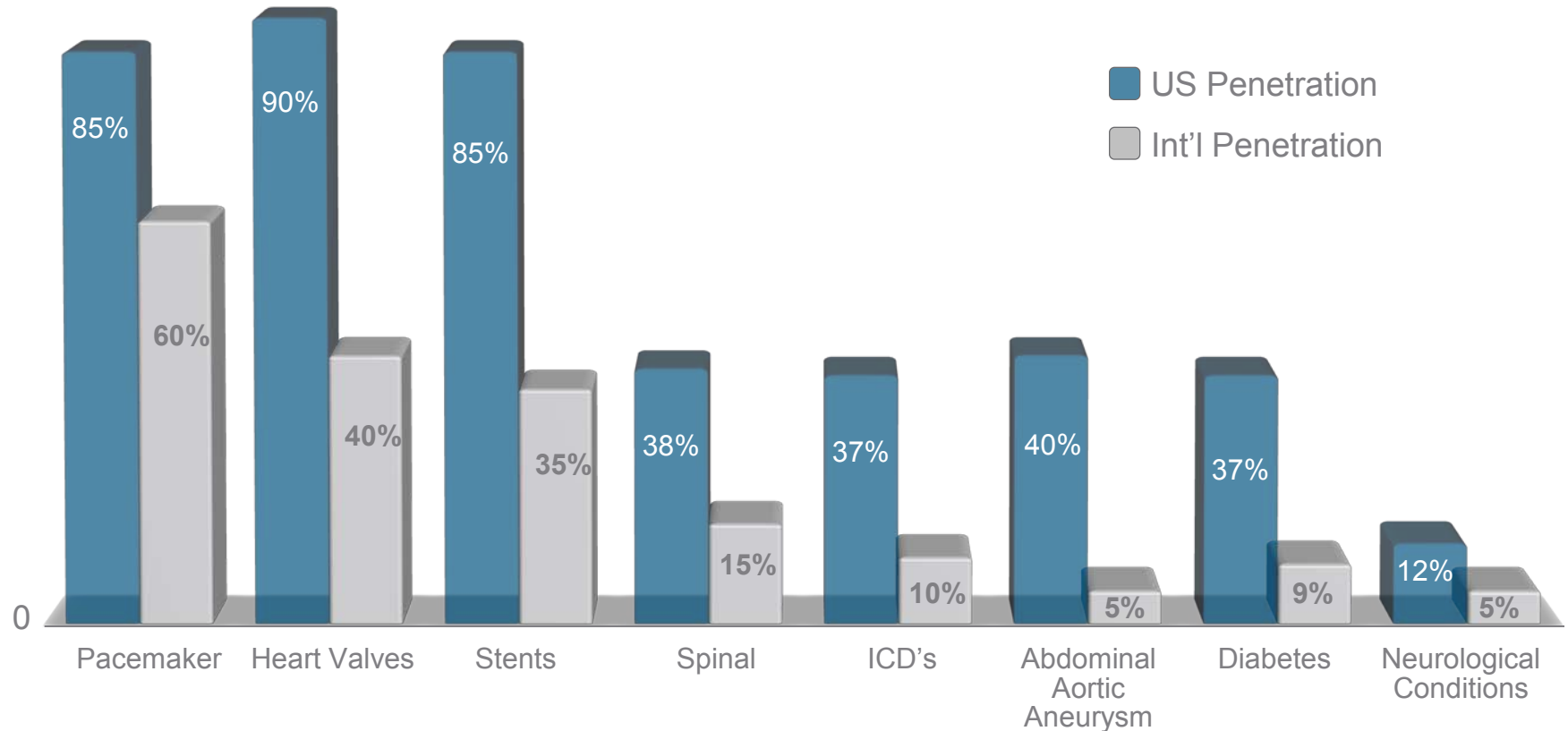
# The Need to Curb Rising Healthcare Costs

### U.S. Health Expenditures



# Many Populations Still Underserved

100%

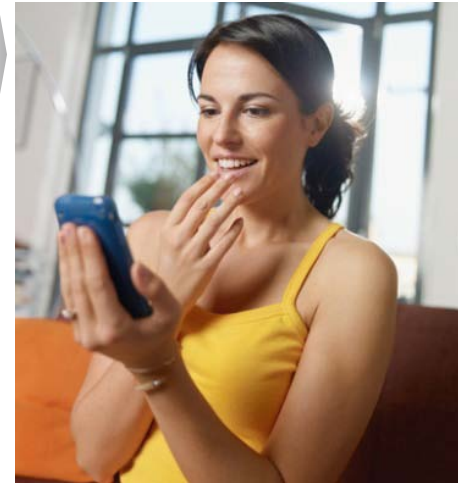
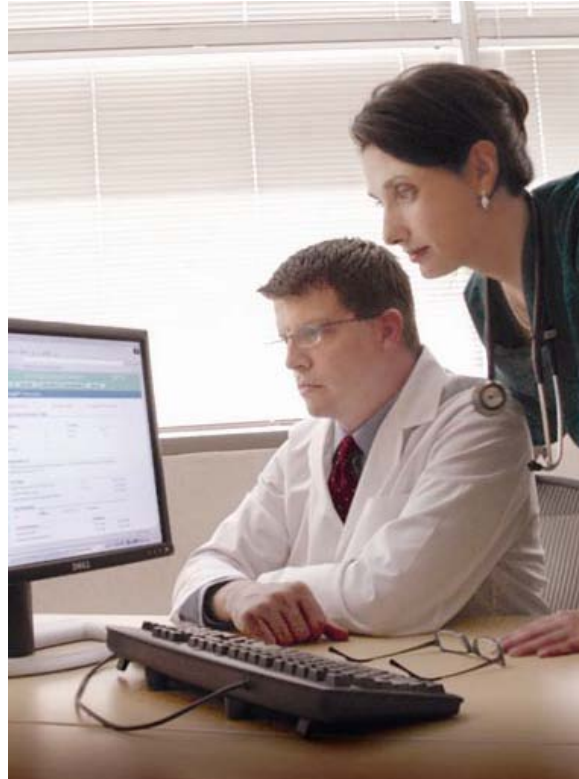


Source: Internal Medtronic analysis

# Opportunity

- Healthcare and Medical Devices are a big part of the world wide Economy
- Need to make Healthcare more affordable
- Possibility to improve national and world wide health at the same time we reduce Healthcare costs.
- Prevention and proactive management are far more economical and effective than reactive medicine.
- “Onboard diagnostics” for personal health.
- CPS enables safety features such as fault tolerance, therapy modification, and patient and product management in the event of performance issues (environmental or reliability)

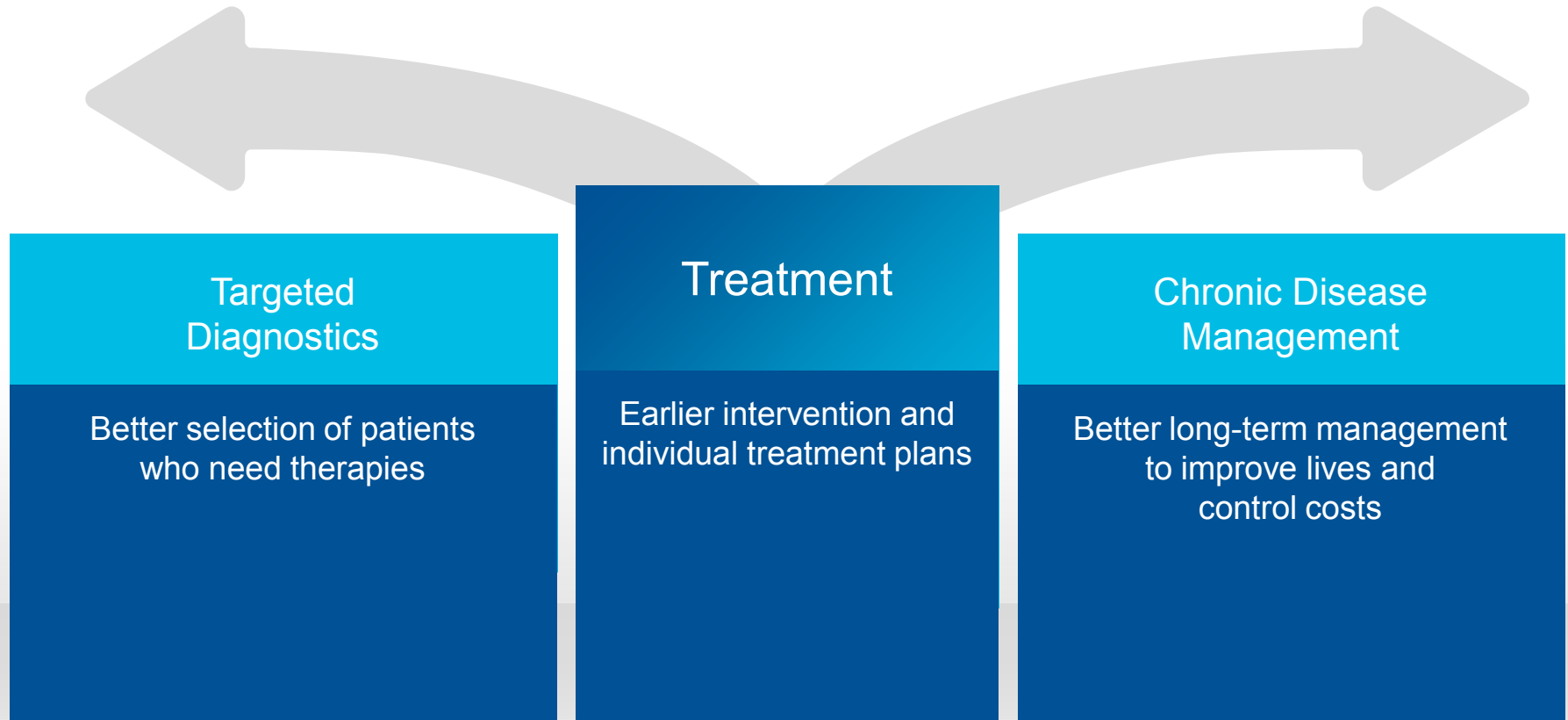
# Information Technology to Monitor Patients



For full safety information, visit [medtronic.com](http://medtronic.com)

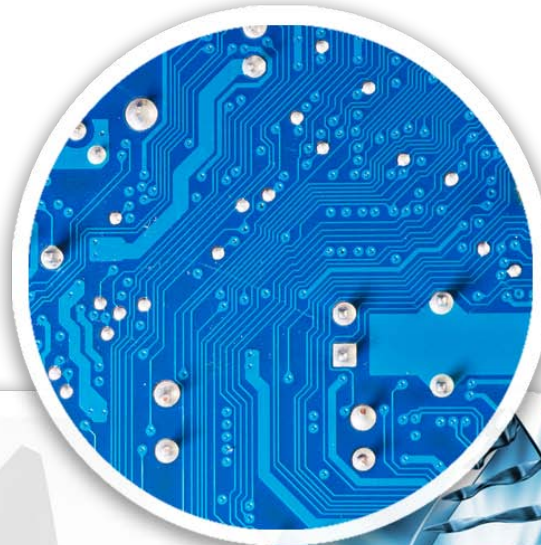
# Providing Therapies Across More of the Care Continuum

*CPS is moving from playing an integral role in treatment of an existing condition – to being the center the whole care continuum.*



# Combining Core Technologies for Greater Impact

Information  
Technology



CPS enabled  
Engineering  
Sciences



Life Sciences



# Challenges

- Healthcare IT infrastructure is heterogeneous
- No overall integration strategy – Industry currently develops application specific infrastructure – costly
- As system complexity increases, more issues are seen in the field – regulatory and media reaction results in more caution towards innovation.
- Security.
  - Systems connect directly to the human physiological system.
  - Systems are connected to IT infrastructure in the Healthcare industry.
- Technology
  - Low power
  - Biocompatible – or biocompatible encapsulation
  - Communication



# Challenges

- Regulations and the industry focus is on a proving that a specific treatment of a medical condition is safe and effective. CPS use and complexity is accelerating, and current practice isn't well suited to driving the right assessment of product in development or for market use.
  - *the benefits of fault tolerant design added to a system currently result in additional regulatory effort over and above basic therapy.*
  - We need a safe, standardized way to manage Risk/Benefit when incorporating CPS in a treatment strategy that may enable multiple operational profiles, and not constrain itself to standard reliability and safety limitations. “Onboard diagnostics” for personal health.
  - No easy balance for healthcare economics relative to leveraging CPS
    - Revenue via insurance comes from treating the sick, not preventing sickness, or managing patients.
    - Hospitals can become more economically efficient and effective in treating patients if we can enable them to manage to the continuum