

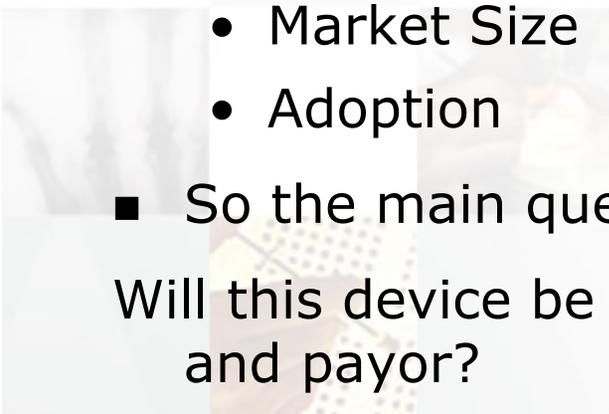
Medical Device Market Opportunities for Nanotechnology

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Ventures



VC Thinking on Funding Nanotechnology

- VC Thinking - Not an oxymoron
- Ultimate goal of any investment is substantial return on investment within time frame
- What drives exit? Ramping Revenues!
- What drives Sales?
 - Market Size
 - Adoption
- So the main question VCs have is:
Will this device be rapidly adopted by physicians, patients, and payor?



Frazier Healthcare Ventures

- Seattle based venture capital firm
- \$750 Million under management
- Exclusively healthcare focused
- Significant start-up experience
- Nanotechnology Interest



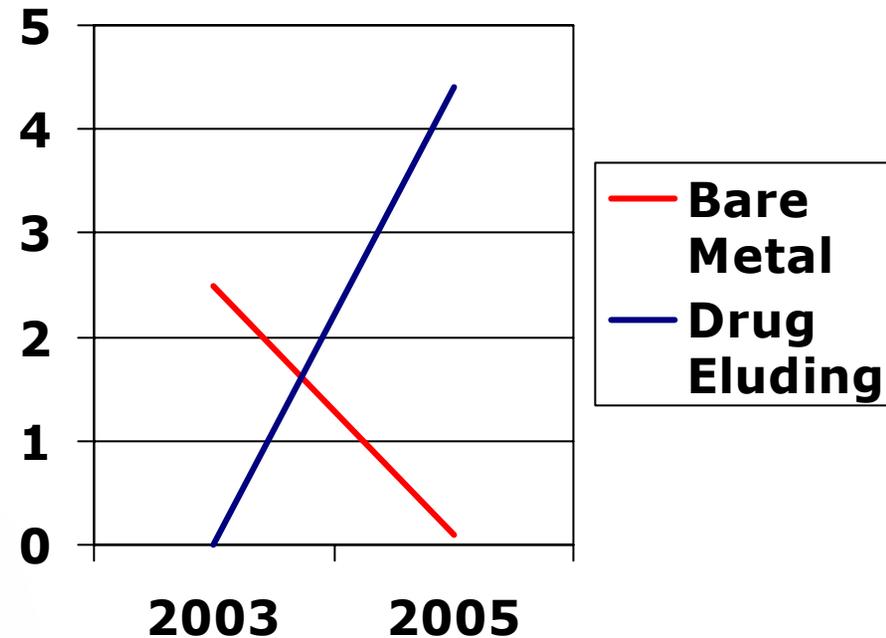
Nanotech Effect on Medical Device Markets

- Nanotech can improve devices two ways
 - Decrease size
 - Improves ease of delivery
 - Increases accessible sites
 - Increase functionality
 - Adds functions to devices that are already small enough
 - Creates active devices from passive one
- Growth of Nanotech Devices
 - Capture very large existing
 - Meeting unmet medical challenges
- When nanotech addresses the first major device market the pace of medical device nanotech adoption will rapidly grow.

Coronary Stent Market Example

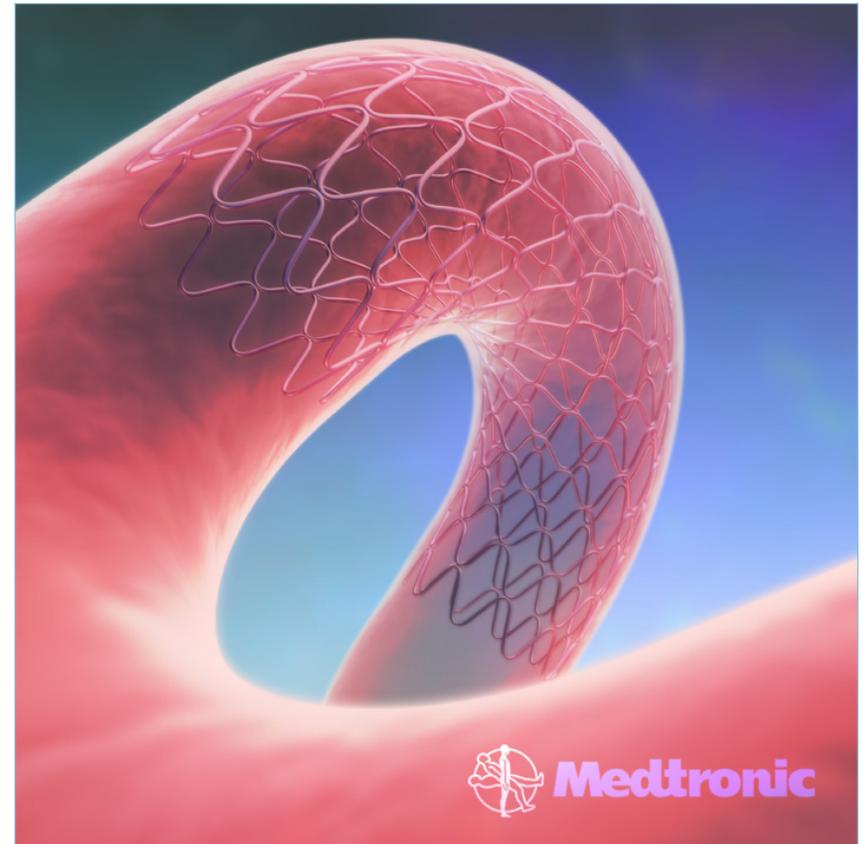
- Bare Metal Stents grew very rapidly into a multi-B market
- Problem of restenosis – 30% of stented arteries reclosed
- Drug-eluting stents were introduced
- Rapidly captured 90% of market
- Reaction of device companies: PANIC

Sales in \$Billions



Coronary Stent Example

- Stents don't need to be made smaller, they need to work better
- If DES capture 90% of market, imagine a stent that could:
 - Increase blood flow
 - Deliver multiple drugs into heart
 - Monitor blood flow
 - Deliver itself or assemble in place
 - Filter out fat

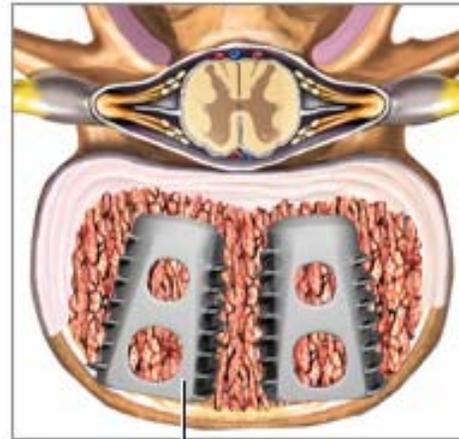


Spine Fusion Example

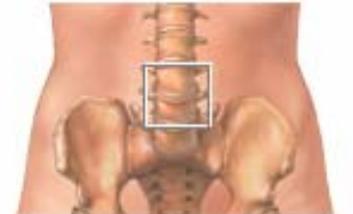
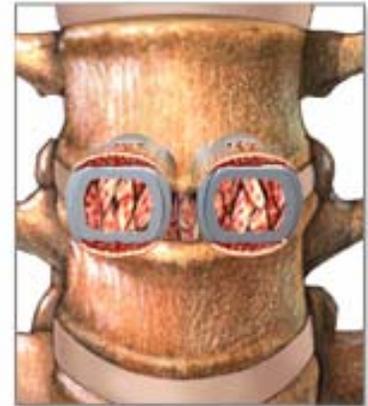
- 400,000 Spinal fusion procedures/yr
- The devices hold the vertebrae still while the bone grafts fuse with the surrounding bone
- Medtronic introduced a fusion cage that delivers BMP, a protein that grows bone
- Doing about \$300M revenue

Interbody cage fusion uses a hollow threaded cylinder filled with bone graft to fuse two vertebrae

Top view

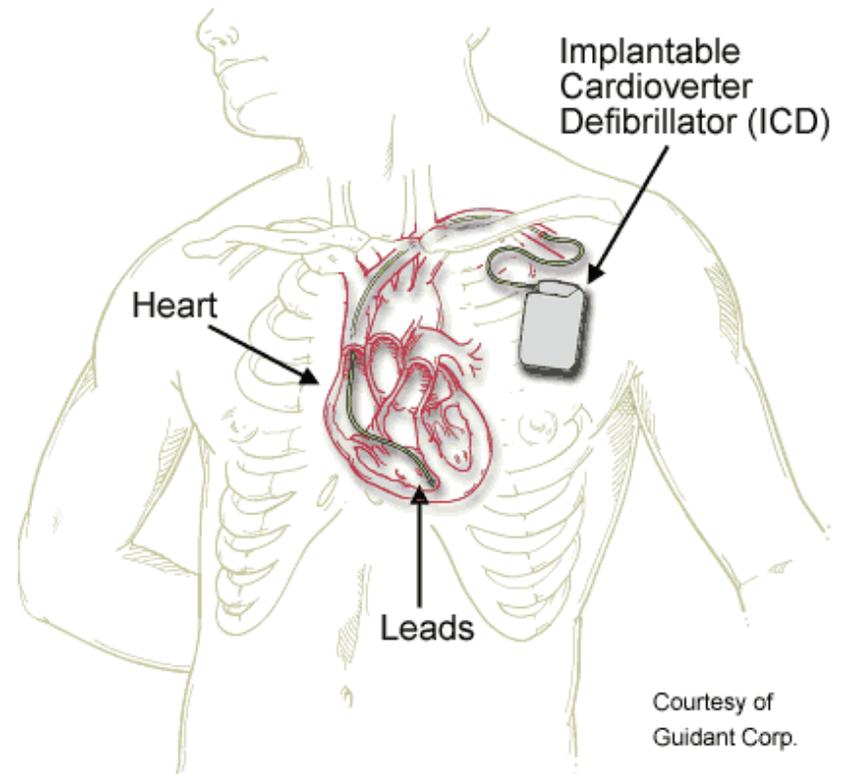


Interbody cage



Implantable Defibrillator Market

- One of the most profitable, fastest growing markets
- \$4B/yr split between 3 companies
- Great data on mortality reduction in specific populations
- Implantation is a problem – has to be done by electrophysiologists

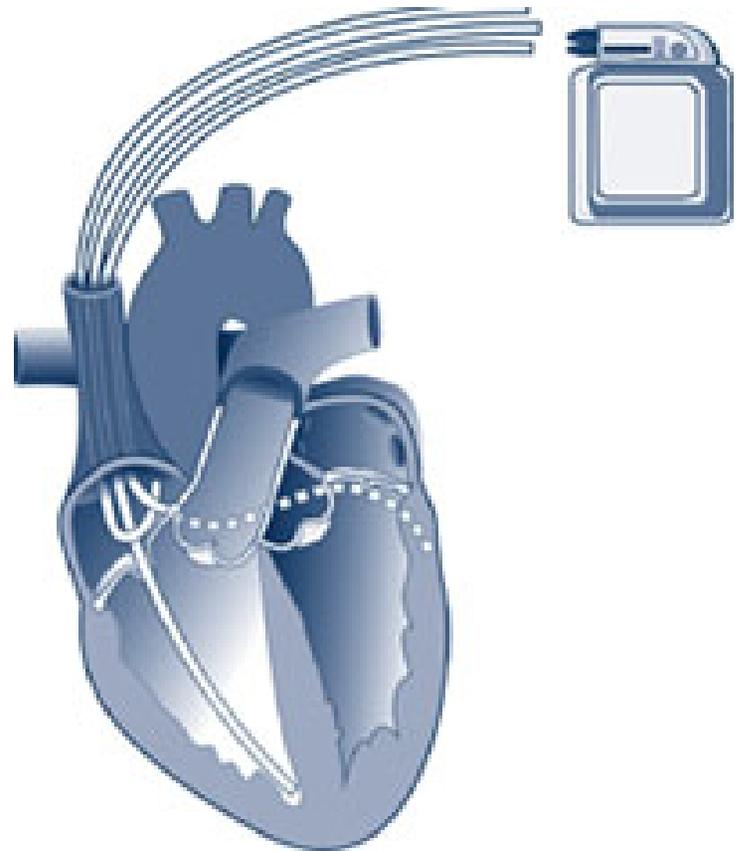


Nanotech Implantable Defibrillator

- Size- an ICD that could be delivered by the cardiologist would capture most of the market
- If small enough, could be incorporated into coronary stents – allowing access to all areas of the heart
- Ultimate goal - Circulating nanobots electrical stimulation delivered to heart and other organs as needed

Biventricular Pacing

- Biventricular pacing – treatment for CHF
 - Very large market - \$1B by 2005
 - Current implantation procedure difficult and time consuming
- Again – Nanotech version that avoids implantation problems would be rapidly adopted

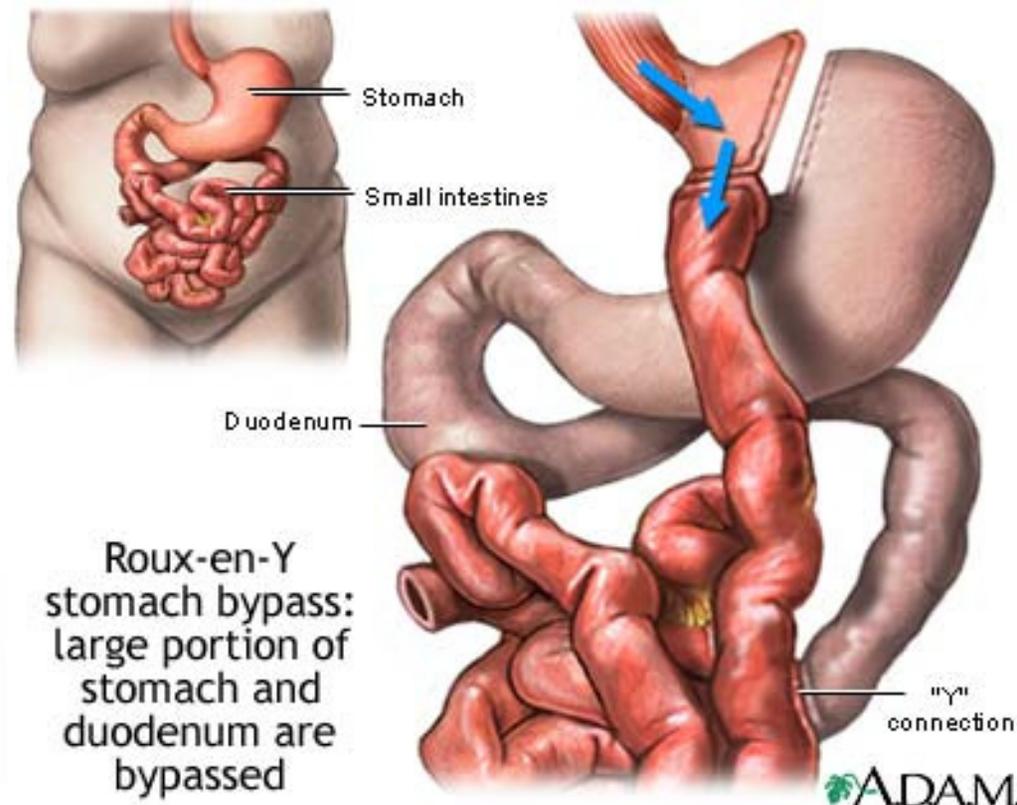


Unmet Medical Challenges

- Significant medical challenges that are not currently treated with medical devices
 - Obesity
 - Hypertension
 - Neurological Disorders (Alzheimer's)
- Other challenges are significantly undertreated
 - Stroke
 - Congestive Heart Failure
 - Diabetes
 - Organ Replacement
 - Respiratory Failure

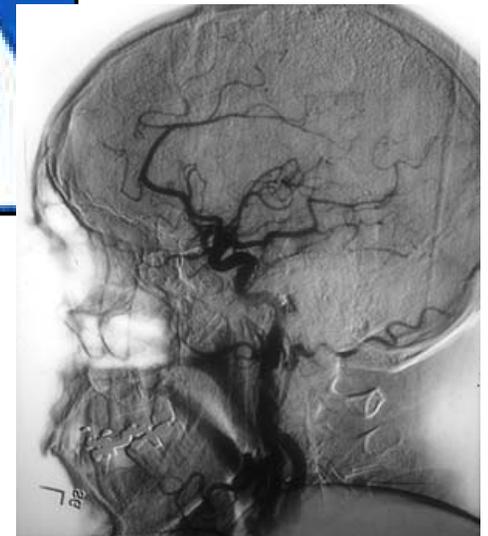
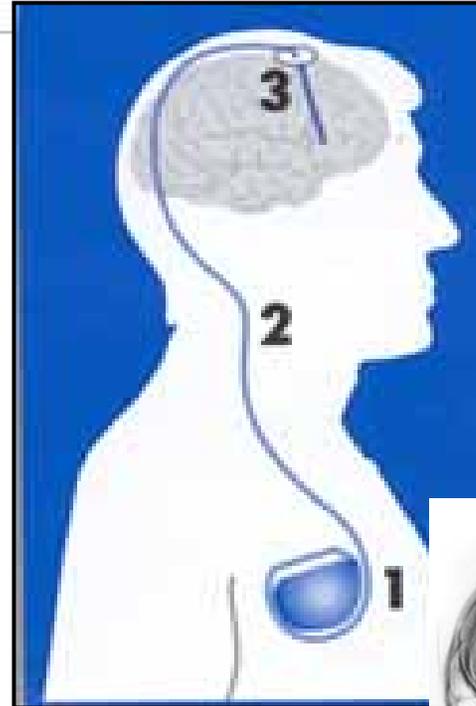
Obesity Therapy

- Gastric bypass is an effective surgery for obesity
- Many start-up device companies are pursuing minimally invasive or endoscopic alternatives to surgery
- One start-up is pursuing nanoparticles to create feeling of fullness in the stomach
- Other companies developing gastric or vagus nerve stimulation technologies
 - Nanostimulation technologies that allow selective nerve stimulation or ease of implantation



Neurostimulation

- Electrical stimulation of neural tissue is successful in treating diseases such as Parkinson's and is under study for stroke
- Delivery into the specific areas of the brain is requires neurosurgery
- Miniaturization would allow delivery through the vasculature without surgery



Respiratory Failure

- Current treatment is oxygen supplementation and ventilator support
- Technology currently exists to provide gas transport ex-vivo
- Miniaturization of current technology to provide a short-term implantable support or long-term artificial lung
- Future – Artificial circulating “Respirocytes” providing gas transport

Futuristic Nanotech Applications

- Vasculoid: Nanomedical Replacement for Human Blood
 - Envisioned by Robert Freitas
 - 500 Trillion individual nanorobots
 - Performs all blood functions
 - Excludes parasites, bacteria, viruses, and cancer
 - Eliminates all vascular disease, heart disease, stroke, etc