Wireless control in nanostructures and bionetworks in health care and medicine

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Telemetry for home monitoring of cardiac vital signs

AICD - 23% reduction in mortality from sudden cardiac death

Cleland et al., J Am Coll Cardiol (2005) – TEN-HMS Trial

The NEW ENGLAND JOURNAL of MEDICINE

Amiodarone or an Implantable Cardioverter–Defibrillator for Congestive Heart Failure

AICD - 23% reduction in mortality from sudden cardiac death

http://www.heartonline.org/defibrillator.htm
State of the art

• Nothing yet includes both nanostructures + control + wireless (investment needed?)
• Emerging technologies that combine one or more of these components:
  – Retinal imaging for diagnostics
  – Continuous telemetry +/- therapeutic intervention (e.g. AICD)
  – Magnetic nanoparticles for MRI
Challenges

• Scalability of sensing components
• Designing interfaces between electrical signals and biological systems (esp at nanoscale)
• Signal amplification (need good transducer)
• Monitoring/measurement to assess device performance
Promising directions/paradigm shifts

• Wireless assembly/actuation of nanoscale structures for cell-directed therapy
• Noninvasive diagnosis/monitoring/risk stratification
• Combinatorial therapy (sensing, complex systems control, delivery)
• Magnetic nanoparticle manipulation
• Nanoscale optogenetics?
• Accelerated drug discovery and personalized medicine
Economic/ethical issues

• Toxicity (to patient and to public)
• Encryption of wireless health data
• Importance of educating public about nanotechnology and synthetic biology
• Information overload – i.e. how do we manage and clinically act on all of the data