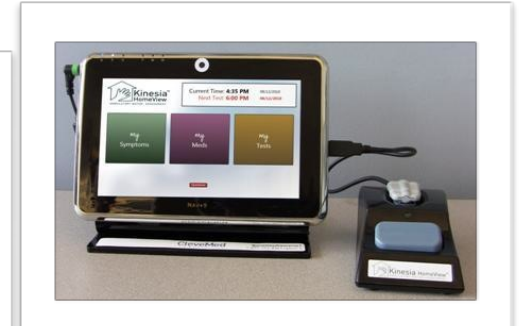
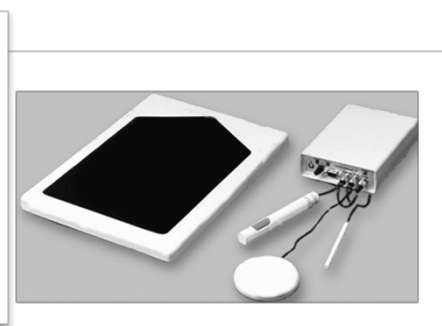
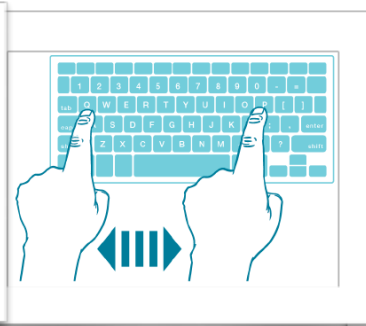
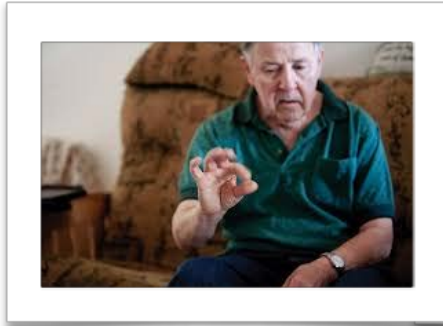


Challenges & Promises of digital biomarkers in the quantification of motor function

Spyros Papapetropoulos MD, PhD

Technology is Changing Fast

Example: The evolution of finger tapping



1980

1990

2000

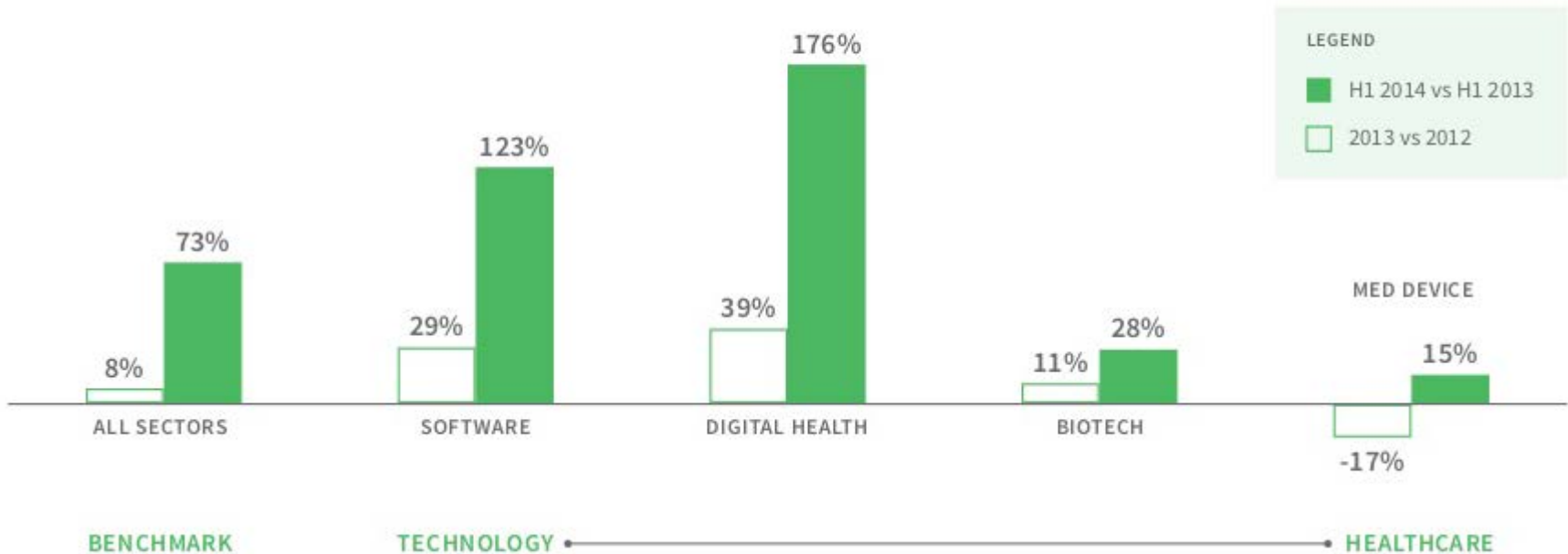
2010



Venture funding of digital health continues to significantly outpace traditional healthcare sectors

PACESETTER

Change in venture capital funding (2013 versus 2012 and H1 2014 versus H1 2013)



Source: PwC MoneyTree, digital health data based on Rock Health analysis
Note: Digital health only includes deals >\$2M

Opportunities with Chronic Disease Management

As care shifts from episodic to continuous, there is tremendous opportunity to support the management of chronic diseases for all participants:

- **Patient**
 - Engagement (real time visualization), empowerment (intelligent automated interventions), and accountability (self care) to increase adherence and improve outcomes.
- **Payer**
 - Patient self-management and continuous monitoring increases adherence, reduces costs, and improves outcomes.
- **Pharma/Tech Industry**
 - New products
 - Patient behavior data provide insights that inform R&D and Marketing.
 - Med adherence
- **Physician/Care Team**
 - Continuous care data enables exception-based alerts.
 - Better manage the complexity of communication among the care team; keep track of
 - what everyone on the care team is doing.
- **Research (next slide)**

The adoption of technology creates news opportunity in clinical research

- Greater accuracy, sensitivity of collected data/ efficacy measure
- Enables much richer data sets through the addition of more contextual information
- Improved protocol patient compliance, less missing data, out of window events
- Greater flexibility with user inputs (participants have more choice over input devices)
- A new avenue to connect with Investigators, study personnel and subjects
- Real-time quality tracking
- Decrease in-person clinic visits, while maintaining high quality care and engagement
- Reduce study costs
- Enable new type of research protocols if combined with eVisits



Proposed Roadmap – Long term objectives for HD

- Quantify symptoms even in prodromal disease stages
- Longitudinally monitor for phenoconversion
- Identify new disease phenotypes
- Monitor disease progression
- Increase adherence-compliance
- Personalize treatments
- Speed trials and reduce cost
- Closed loop therapeutics

Validated solutions will eventually improve the quality of care and could be deployed in real-world settings

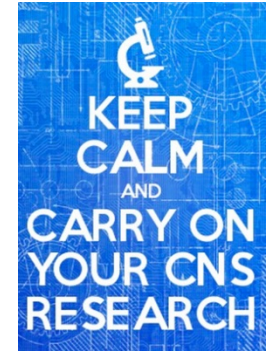
Challenges

- Open loop capture of isolated data – lack of actionable data and multi modal recordings
- Multiplicity of solutions - interchangeability
- Discrepancies with established measures
- Correlation with clinical significance
- High burden to value ratio (ie battery life and complexity in UI)
- Regulatory challenges
- Analytics limitations
- Privacy regulations

More Challenges

- Access to technology
- Lexicon of common terms
- Version control management
- Business case/reimbursement: who will pay for technology?
- Globalization

THANK YOU!



"This really is an innovative approach, but I'm afraid we can't consider it. It's never been done before."