New Frontiers in Personalized Medicine

Oracle Open World Shanghai 2013

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Safe Harbor Statement

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Oracle's Investment in Innovation and Integration

MORE THAN $24B IN R&D SINCE 2004

Figures in GAAP
Five Forces Transforming Healthcare

**CLINICAL INNOVATION**
New technologies, devices, medicines, treatment methods, and delivery models

**REGULATORY SCRUTINY**
New rules, new agencies, increased compliance risk, and global complexity

**COMPETITIVE THREATS**
Innovators in adjacent sectors are forcing incumbents to rethink value propositions

**PERSONALIZED MEDICINE**
New expectations of quality, service, and affordability; ever increasing appetite for data

**ECONOMIC CONSTRAINTS**
Cost constraints that threaten margins, drive consolidation, and reward efficiency and scale

We believe in a more predictive, preventive, personalized and participatory system to improve human health.

We believe that Oracle can help enable personalized medicine through data and insights.

Why: Oracle Health Sciences exists to enable people to live healthier lives.

How: Oracle Health Sciences enables companies and institutions to help improve human health through information technology innovation.

What: Oracle Health Sciences provides cloud-based solutions to improve human health.
Maximizing the Benefits from Innovation

71% of companies say that innovation is the #1 factor in competitiveness

Leading companies use IT to **empower their people** to drive innovation and change

However, 70-90% of companies do not use IT to its potential
IT Spending Distribution

Integration and Collaboration Across Health Sciences

Four distinct big data pools exist in the healthcare and life sciences domain today with little overlap in ownership and limited integration.

- Pharma/Med Device R&D Data
  - Owner: Life sciences companies, academia
  - Example data sets: Clinical trial data, high throughput screening (HTS libraries)

- Clinical Data
  - Owner: Providers, Pharmacies, Labs
  - Example data sets: Electronic medical records, medical images, patient family histories

- Activity (Claims) and Cost Data
  - Owner: Payers, providers
  - Example data sets: Utilization of care, care patterns, cost estimates

- Patient Behavior and Sentiment Data
  - Owner: Various, including consumer stakeholders outside healthcare (e.g., retail, home electronics)
  - Example data sets: Patient behaviors and preferences, retail purchase history, exercise data, diet, family history/genealogy

Source: McKinsey Global Institute Analysis
Oracle’s Health Sciences Data Management Suite
Supports Four Solution Areas For “Secondary Use” Of Healthcare Data

Enterprise Healthcare Analytics
(Hospitals, Clinics, IDNs, Payers)
- Quality and safety
- Clinical analytics
- Revenue cycle
- Clinician performance
- Decision support

Translational Research Center
(Academic Medical Centers, Research Organizations & Pharma)
- Patient Cohort Identification and Selection
- Statistical & Scientific Analysis
- Biomarker Research

Patient Engagement*
(Pharma, Medical Devices, Providers, Payers)
- Outcomes-based reimbursement
- Care and Disease management
- Utilization management
- Healthcare Pay-for-Performance Mgt

Health Sciences Network
(Pharma, AMC, CROs, Payers)
- Clinical Trial Optimization – Protocol Validation, Recruitment, Late Phase monitoring
- Safety & Pharmacovigilance
- Biomarker Discovery
- Comparative Effectiveness Research

* Medication Adherence application expected to be Generally Available in FY14
Opportunities for Translational Medicine
Utilizing Genomic Advances in the Delivery of Health Care

- High-quality standardized clinical data with appropriate levels of security and access control
- Integration and analysis of cross-platform omics data agnostic to scientific approach & technology
- Analysis of internal datasets in the context of ever-increasing large public domain data sets
- Using public domain reference datasets, provides powerful out of the box biological context ready for immediate query
- Biomarker identification and validation through a single integrated analysis-ready view of clinical and omics data
Translational Medicine Use Cases

- Find patients that are poor responders for drug Y and have a mutation in the promoter region of Gene X.
- What is the expression level of TP53 mutants by cancer tissue?
- How many patients have disease Z, responded to treatment, have a chromosome 18 deletion and have blood samples in the biobank?
- Do mutations in the coding sequence of Gene X perturbs its expression across all projects?
- Show HER+ cell lines that have ERBB2 copy number gains.
- Filter the gene variants found in chromosome region X by quality score and read depth.
- Take only the exome portion of the whole genome and do a statistical association analysis with phenotype Z and then prioritise the genes based on their variant type (e.g. non-syn SNPs), annotations (e.g. growth factors) and membership to known pathways.
Key Components of a Hospital Analytics and Translational Medicine Solution

**Oracle Analytic Apps**

- EHA Platform
- EHA “App Exchange”
- Oracle Analytic Apps
- Partner Apps
- Custom Apps

**Master Data Management & Other Services**
- Omics Loaders
- Omics Data Bank
- Healthcare Data Model
- Oracle Healthcare Analytics Data Integration

**Data Integration**
- Oracle Data Integrator
- Oracle Database

**Enterprise Data Warehouse / Data Model**
- De-identification
- NLP
- ... (Unit of Measure)
- MPI
- Term. Service

**Analytics & Reporting**
- Cohort Explorer
- Omics Explorer
- Operating Room Analytics
- Provider Supply Chain Analytics
- Registries
- Quality Reporting
- Revenue Cycle
- Pharmaco-vigilance

**Departments & Users**
- Exec
- Administrator
- Clinician
- Staff
- Researcher

**Systems**
- Biobanks
- Clinical Systems
- Financial Systems
- Administrative Systems
- Research Systems

**Oracle Systems**
- Oracle Database
- Oracle Data Integrator
- Omics Data Bank
- Healthcare Data Model
- Oracle Analytic Apps

**Other Systems**
- INFA
- Oracle Data Integrator
- Database Warehouse / Data Model
- Omics Data Bank
- Data Integration

**Terminology**
- MPI
- Unit of Measure
- De-identification
- NLP

**Applications**
- Cohort Explorer
- Omics Explorer
- Operating Room Analytics
- Provider Supply Chain Analytics
- Registries
- Quality Reporting
- Revenue Cycle
- Pharmaco-vigilance
“As we focus on the next-generation of treatments – including our Moon Shots Program – we require a powerful analytical infrastructure that can yield new insight from the unprecedented volume of data available today,” said John Frenzel, MD, chief medical information officer, MD Anderson.

Frenzel added that Oracle’s applications and technology stack would help provide “one of the robust foundations that we need to accelerate deployment, and ultimately, discovery of life-saving treatments,”

The new platform will bring together clinical, genomic, financial, administrative and operational information from internal and external sources to yield insights that drive care innovation and optimize operational efficiency.

“Leveraging data and information to drive more effective resource utilization, improve operational efficiency, and level patient volumes across the days of the week is becoming increasingly more important,” said Craig Owen, director of clinical analytics and informatics at MD Anderson.
The Opportunity to Improve Medication Adherence

25 - 50% of clinical trial participants do not take medications as prescribed.
Ingestible Monitors and Sensor-based Data

Proteus Digital Health solutions for medication adherence and continuous patient monitoring

Ingestible Monitor
- Medication
- Dose
- Timing
- Adherence
- Supply Chain

Wearable Sensor
- Heart Rate
- Respiration
- Activity
- Posture
- Gait
- Sleep
- Stress
- Temperature

Mobile Applications
- Sociability
- Engagement
- Cognitive Assessment
- Environment
- Location
- Context

Subjective Information
- Side Effect
- Symptoms
- QOL
- Mood
- Emotion

Proteus Digital Health raises $45 million, inks clinical trials deal with Oracle

By: Brian Dolan | May 1, 2013

Ingestible sensor activated upon fluid contact

Phone receives data from patch, forwards to Oracle Health Sciences Cloud. Analytics sent to customers from the Oracle Health Science Cloud.

Patch attached to user and paired to phone, data uploaded periodic and automatically

Complex, Scalable System Invisible to User
Information not Data, Automatically

Patient/Caregiver Networks

Web/Mobile Apps

Analytics

Clinician analytics and Clinical Trial tools
Oracle Health Sciences “Big Data” Architecture

Data Integration
- Oracle Data Integrator
  - Connectivity Framework
  - Pluggable Transport Layer
  - JMS, JDBC, ODBC, SOAP, Other
  - Pluggable Data Formats/Structures

Data Federation
- Oracle Database
- Hadoop / HDFS

Data Virtualization
- 10g Data Service Integrator
  - 12c Data Virtualization

Data Visualization
- Oracle Business Intelligence
  - ADF (custom views)
  - Open (3rd party views)

Event Processing
- Oracle Event Processing
  - Input
  - Output

Real-Time Decisions
- Oracle Real-Time Decisions

Sense, Respond & Decide
- Acquire
- Organize & Analyze
- Decide
Integrated Data Providing a 360° View of Your Health

Identified and De-Identified Data Powering Behavioral Insights and Management

- Personal Data
- Institutional Data

Data Integration SPI (SDK/API)

Customer Data
3rd Party Apps and 3rd Party Data
Oracle Apps Data
Device Data

360° View of the Individual
- Identified
- De-identified

Behavioral Management

Social Graph

Behavior Graph

Physical Graph (Device Data)

Holistic Longitudinal Individual Data and Insights
Federated Data Access using Virtual Data Models