It’s a Challenge of Scale*

1. A Commercial
2. Motivation, dilemmas
3. Community HC Perspective - complex & large, and getting harder & bigger
4. With systems & structures that are already not intuitive enough

*We’re an end user of technology. A systems integrator.
Virtua Health Today

4 South NJ Acute Care Hospitals
Berlin, Marlton, Mount Holly, Voorhees

Outpatient Center, inc. ED
Camden

2 Long-Term Care Facilities
Berlin, Mount Holly

2 Home Health Services
Camden & Burlington Counties

2 Ambulatory Surgery Centers
Voorhees, Mount Holly
Virtua – Mid-Size Integrated Delivery Network

7,200 Employees
2,100 Physicians
56,000 Annual Admissions
270,000 Outpatient Visits
7,600+ deliveries (2006)
176,865 ED visits
1,200 Beds
What Makes Virtua Different?

Relentless measurement
Rigor and accountability
Our Tool Box
Programs of Excellence
Partnerships with Industry
Our people
Our results
The Virtua STAR:
The Backbone of Our Organization

Excellent Service
Outstanding Patient Experience
Best People
Clinical Quality & Safety
Resource Stewardship
Caring Culture
It’s a Challenge of Scale

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3. It’s complex & large, and getting harder & bigger
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Burning Platform: Medicare Should Keep Pushing US in Quality, Safety

Patients receive recommended care 55% of the time...

- All care: 55%
- Acute: 54%
- Chronic: 56%
- Preventive: 55%

Patients Reporting Any Error by Number of Doctors Seen in Past Two Years, Sicker Adults, 2005

2005 Commonwealth Fund International Health Policy Survey of Sicker Adults
Account for

44,000 - 98,000 deaths per year

in the United States

More people die from medical errors than from breast cancer or AIDS or motor vehicle accidents

Thomas et al. 1999

Direct health care costs totaling

$9 - 15 billion per year

Thomas et al. 1999
Johnson et al. 1992
Dilemma: Spending Stifling Our International Competitiveness

In Summary: we’re the best at treating chronic, acute care, but still die younger.

• US healthcare is called-in after the fact: Americans (esp. NJ) do not take responsibility for their own health.
• It’s not just a value-chain length or an acute care problem.
• It is very difficult to see the whole person, anticipate, prevent or treat a health issue holistically.

• US Healthcare remains specialized compendium of silos and compartments with distinct care processes and protocols.

[Graphs and data tables as shown in the image]
Germans Live Longer and for Less

Better outcomes and costs thru longitudinal patient care:

> 80 million electronic health cards
All phases of care
Access to medical data (opt in)
Gov’t and private health insurance
> 750 million prescriptions every year
Annual savings > 1 billion euros

www.euser-eu.org
No Sunk Costs, No Baggage

Slovenia’s 2nd generation Web-based system 2007 launch
We Cost Too Much (2X healthier countries). Healthy Patients are Leaving the US.

OFFSHORE
Is less than 1/3 our costs
Burning Platform: countries). Healthy Patients are Leaving the US.

Improving the Bottom Line

<table>
<thead>
<tr>
<th>Patient Volumes</th>
<th>2000</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousands</td>
<td>635</td>
<td>1,000</td>
</tr>
</tbody>
</table>

57% increase in volumes; no increase in back office staff

<table>
<thead>
<tr>
<th>Gross Profit Margins</th>
<th>1997</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>20%</td>
<td>33%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>US Price</th>
<th>Procedure</th>
<th>Foreign Price including Travel Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>$40,000</td>
<td>Spinal surgery</td>
<td>$6,404</td>
</tr>
<tr>
<td>$16,000</td>
<td>Hernia repair; removal of testicular cysts</td>
<td>$4,900</td>
</tr>
<tr>
<td>$10,335</td>
<td>Knee surgery</td>
<td>$1,321</td>
</tr>
<tr>
<td>$7,065</td>
<td>Varicose vein surgery</td>
<td>$1,411</td>
</tr>
<tr>
<td>$6,046</td>
<td>Bunionectomy</td>
<td>$1,502</td>
</tr>
<tr>
<td>$5,663</td>
<td>Tubal ligation</td>
<td>$1,280</td>
</tr>
</tbody>
</table>

The Clincher.....
Exacerbated by Staffing Shortage

Med School Grads

US Nursing Workforce

Senior Metro North America Population

Solution - productivity

- Less in-patient, acute care
  - In-home
  - Ambulatory
- Productivity thru process, technology
  - Process optimization
  - Automate what you can
  - Flat world…
Solution: New Model of Care Systems

FROM - Reactive Cottage Industry & Individual Craft:
• Americans do not take responsibility for their own health
• Healthcare is called-in after the fact in generally isolated forms
• Result: we’re the best in the world at treating chronic, acute conditions

TO – Proactive, Connected Healthcare:
• Expand scope of care to cover all phases of life, prior to conception until after death
• Shift the industry culture from reactive to proactive, crisis to prevention
• Result: Unified, preventative, holistic care processes & teams enabled by technology
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Example: 75 YOM Diabetic, > 10,000 Transactions
Personalized Med-Mania

Solution – Larger scale systems:
- Decision support systems
- Realtime, on-line I’s and O’s
- Automated H&Ps, notes, etc.
- Medication management
- Proactive diagnosis, therapy assist
- Realtime coding (charging)

As if medication & therapy management was not hard enough…
- Add genetically tailored meds
- Add ten times the codes, protocols with ICD-10 in 2010

The open bars represent the theoretical probabilities of a drug-drug interaction occurring. The solid bars represent potential interactions identified in patients.

One Simple Transaction

Paper Processes Invite Errors, Make for a Clerical Day

Ancillary

LAB

Old Charts

FLOWSHEET

Dangerous Chart

Daily Report

MONITOR

IMAGE

PUMP

MAR

Results Review
Documentation
Communication
Orders
Billing

> 55% of the time

Leaving less than half for our time real patient care
 Patients move faster than charts

> 60% of the time
Community Healthcare Under the Hood

- 4M Transactions per day, across
- Over 220 Applications, Servers but dropping
- CCW: logical messaging, physical messaging, WAN
Digital Transformation Increases Computing Infrastructure

Server Growth
• Net new functionality - create new operating system, database, etc. licenses
• In house only
• Some services and servers get retired

Client Growth
• Each project creates new applications... some get retired
• Creates new mobile, portable and/or desktop license requirements
• Net new employees
Traditional Inpatient-Focused Architecture
Typical Architecture – 315 Best-of-Breed Services and Growing

**CORE IT SYSTEMS**
- Clinical Applications:
  - Order processing
  - Nursing Documentation
  - Electronic Medication Administration Record (eMAR)
- Patient Management & Accounting
- Administrative, Financial Applications
- Human Resources, Staff Mngt.

**ADVANCED CLINICALS**
- Clinical Data Repository (CDR)
- Electronic Medical Record (EMR)
- Computerized Provider Order Entry (CPOE)
- Evidence-Based Medicine

**TEACHING/RESEARCH**
- Video Conferencing
- OR Theater
- Web-based Education
- Specialty Applications

**“SMART” TECHNOLOGY**
- Stretcher, Beds
- Nurse Call
- Patient Cards
- Phones

**BIOINFORMATICS**
- Computer-aided Diagnosis
- Computer-aided Surgery
- Robotics

**POINT OF CARE TECHNOLOGY**
- Bar Coding/RF/Infrared
- Voice Recognition
- Lab Testing
- Handheld Devices

**BIOTECHNOLOGY**
- Genomics
- Molecular Imaging
- Polymers
- Tissue Engineering

**DIGITAL IMAGING**
- Radiology PACS
- Cardiology PACS
- Multi-modality
- 3D

**HORIZONTAL CLINICALS**
- Pharmacy
- Lab
- Dietary
- Transcription
- Etc.

**DEVICE INTEGRATION**
- Medical Equipment
- Medications
- Lab Orders/Results

**TELEMEDICINE**
- Video Conferencing
- Physician/Patient Education
- Remote Monitoring
- Virtual Visitation

**eHEALTH**
- Physician and Patient Portals
- Self-Diagnosis/Care
- Physician Collaboration/Research
- Disease Management
- Remote Monitoring

**INFRASTRUCTURE**
- Voice-over-IP
- Security
- Wireless, Integrated Network
- Healthcare Standards
- High-speed Data Networking
Virtua Health – Current Timeline

2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012

Non-Clinical

Clinical

Misys: Home Care EMR; MICU: EMSChart

IBEX/PICIS ED EMR

OR Digitization

Cardiology

Document Management

HC Exchange

LIS

Pharmacy IS

Electronic Record Phase 1

Electronic Record Phase 2

Electronic Record Phase 3

Electronic Record Phase 4

R0.3

R0.4

R0.5

R1.0

R1.3

R1.4

R1.5

R1.9

R2.5

R4.0

R5.0

R6.0

R7.0

Electronic Record Phase 4

Electronic Record Phase 3

Electronic Record Phase 2

Electronic Record Phase 1

Pharmacy IS

Document Management

HC Exchange

LIS

Cardiology

OR Digitization

IBEX/PICIS ED EMR

Misys: Home Care EMR; MICU: EMSChart
Virtua Health – Current Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-Clinical</th>
<th>Clinical</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>IBEX/PICIS ED EMR</td>
<td>Misys: Home Care EMR; MICU: EMSChart</td>
</tr>
<tr>
<td>2007</td>
<td>Electronic Record Phase 1</td>
<td>R0.3</td>
</tr>
<tr>
<td>2008</td>
<td>Electronic Record Phase 2</td>
<td>R0.4</td>
</tr>
<tr>
<td>2009</td>
<td>Electronic Record Phase 3</td>
<td>R0.5</td>
</tr>
<tr>
<td>2010</td>
<td>Electronic Record Phase 4</td>
<td>R1.0</td>
</tr>
<tr>
<td>2011</td>
<td>Document Management</td>
<td>R1.3</td>
</tr>
<tr>
<td>2012</td>
<td>OR Digitization</td>
<td>R1.4</td>
</tr>
</tbody>
</table>

5 year Transformational Journey:
- > $100M in capital
- > $100MM in operating expenses

- Cardiology
- HC Exchange
- LIS
- R7.0
Recent Launch Successes

• Team efforts working:
  – Home Health EMRs, remote sensing
  – Paramedics with EMRs
  – Material management automation
  – Integrated hemodynamics, cardiology
  – ED automation, tagging, tracking
ED Information System

**Costs**
- $3.2M capital (phase 2&3)
- $300K/yr maint
- 1 FTE Informatic, training support

**Benefits**
- $2.7M/yr charge capture (CBIZ)
- Compliance ↑
- ED thruput ↑ pending process rationalization

<table>
<thead>
<tr>
<th>Red/Unit</th>
<th>Patient Name</th>
<th>Admit Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED 01</td>
<td>Patterson, Brian</td>
<td>01/01/2023</td>
</tr>
<tr>
<td>ED 02</td>
<td>Kaufman, Larry</td>
<td>01/02/2023</td>
</tr>
<tr>
<td>ED 03</td>
<td>Willis, Nancy</td>
<td>01/03/2023</td>
</tr>
<tr>
<td>ED 04</td>
<td>Simpsons, Anthony</td>
<td>01/04/2023</td>
</tr>
<tr>
<td>FT 01</td>
<td>Capper, Kendall</td>
<td>01/01/2023</td>
</tr>
<tr>
<td>TRAUMA 01</td>
<td>Dylan, Underwood</td>
<td>01/05/2023</td>
</tr>
<tr>
<td>WAIT</td>
<td>Brown, Brian</td>
<td>01/06/2023</td>
</tr>
<tr>
<td>WAIT</td>
<td>Medina, Lola</td>
<td>01/07/2023</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient Flow</th>
<th>Greet</th>
<th>Triage</th>
<th>Transfer</th>
<th>Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Info</td>
<td>Enter:</td>
<td>Display:</td>
<td>Ambulance:</td>
<td>Admin:</td>
</tr>
<tr>
<td>Admin</td>
<td>My Patients</td>
<td>PulseCheck</td>
<td>Ambulance (2)</td>
<td>Help:</td>
</tr>
</tbody>
</table>
# Systems of Systems Improving Care

<table>
<thead>
<tr>
<th><strong>Design Goal</strong></th>
<th><strong>Facilitates</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chartless</td>
<td>No medical record file room</td>
</tr>
<tr>
<td>Filmless</td>
<td>No film storage room</td>
</tr>
<tr>
<td>One Network</td>
<td>Low cost, highly integrated data, voice, video, monitoring</td>
</tr>
<tr>
<td>Wireless</td>
<td>Data in/out everywhere needed, patients &amp; visitor access</td>
</tr>
<tr>
<td>Decision Support</td>
<td>The right order sets for quality, productivity</td>
</tr>
<tr>
<td>Documentation</td>
<td>Speed with completeness &amp; compliance (safety, quality, automated coding &amp; charges)</td>
</tr>
<tr>
<td>Staffing Automation</td>
<td>Acuity, skills &amp; credential based, opt-in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Which Enables</strong></th>
<th><strong>Delivering</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical staff spend more time at the bedside</td>
<td>Increased patient satisfaction</td>
</tr>
<tr>
<td>Increased collaboration, communication among care providers</td>
<td>Comfort, compassion replace fear, anxiety</td>
</tr>
<tr>
<td>Vital, real-time patient information available when &amp; where its needed</td>
<td>Speed via real-time decision support</td>
</tr>
<tr>
<td>No duplicate tasks or re-work performed by staff</td>
<td>Evidence-based medicine to get complex diagnosis right</td>
</tr>
<tr>
<td>Staff have efficient &amp; optimized workflows – more patient care, less clerical/administrative tasks</td>
<td>Personalized medicine yielding proactive, predictive care</td>
</tr>
<tr>
<td></td>
<td>A connected South Jersey - Individualized, real-time digital records</td>
</tr>
<tr>
<td></td>
<td>Integrated, future proof, technology-based facility designs</td>
</tr>
</tbody>
</table>
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Recent Launch Successes

- Team efforts working:
  - Home Health EMRs
  - Paramedics with EMRs
  - Material management automation
  - Integrated hemodynamics, cardiology
  - ED automation, tagging, tracking

Big Take Aways After 3 Years of Progress:

- Technology is NOT the problem; process and people transformation is.
- Most caregivers do not get, trust or want to count on technology – it’s too hard to use.
Combating Complexity with an Improved Formula

- New model for collaboration and planning
- Leverage the Virtua toolkit – Six Sigma, Manufacturing Engineers, IT alignment
- Standard deployment, standardized processes

A proven model used in multiple industries, e.g.
- Intermountain Healthcare
- GE
- AT&T

Strategic Plan | Simplify | Digitize | Operationalize
--- | --- | --- | ---
- Simplify before digitizing
- Determine order of magnitude prior to commit date
- Remain nimble without inhibiting progress
Aging US HC Facilities - Collaborative Method for Design

Digital Hospital Planning Update
Concurrent people-process-technology collaborative design:

**Photo Journaling** – Take pictures and notes to capture how the environment can be improved. **Process Mapping** – study patient and clinician flow, analysis for optimal department design to optimize travel distances, access to materials, supplies and information. Drive efficient layout and flow. **Information System Planning** – Crystal ball for “state of the art” care leveraging the best clinical and information technology.
A Nation Becoming Patient-Centric

EMR System Includes:
- Picture archiving and communications system (PACS)
- Computerized physician order entry (CPOE)
- Care delivery organization (CDO)
- Clinical data repository (CDR)
- Controlled medical vocabulary (CMV)
- Clinical decision support system (CDSS) and workflow components of
  - Electronic medication administration record (eMAR)

Provider

Payer-Employer

Web Portal

EMR Environment

Consumer

Provider
Industry Framework – Benchmark Evolves

“Paperless”, RFI-free, fully digital medical records by end of 2010:
- CDO able to contribute to Integrated Community Care
- Community EHR as byproduct of Shared EHR
- Physician documentation (structured)
- Full CDSS (var., comp.) & PACS
- CPOE, CDSS (clinical protocols)

“Paperlite”, RFI-lite by end of 2009, physician doc, orders paper:
- Closed loop med administration
- Clinical documentation (flow sheets)
- Clinical decision checking, inpatient PACS

Digital Building blocks by end of 2008:
- CDR, CMV, CDSS inference engine, document imaging
- Ancillaries - Lab, Rad, Pharmacy
- Ambulatory, outpatient EMRs (disparate)

Glossary:
- Picture archiving and communications system (PACS)
- Computerized physician order entry (CPOE)
- Care delivery organization (CDO)
- Clinical data repository (CDR)
- Electronic Medical Record (EMR)
- Controlled medical vocabulary (CMV)
- Clinical decision support system (CDSS) and workflow components
- Electronic medication administration record (eMAR)
A 2006 study of 107 UHC hospitals found a correlation between this score and AHRQ quality indicators. See [EMR Sophistication Correlates to Hospital Quality Data](#).

- Source: HIMSS Analytics Databases (derived from the Dorenfest IHDS+ Database™) N = 4298

### HIMSS EMR/SEHR Adoption Model Scores Q1 2007

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>% US Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Medical record fully electronic; CDO able to contribute to Integrated Care EHR as byproduct of Shared EHR</td>
<td>0.0%</td>
</tr>
<tr>
<td>6</td>
<td>Physician documentation (structured), full CDSS (var., comp.), PACS</td>
<td>0.3%</td>
</tr>
<tr>
<td>5</td>
<td>CPOE, CDSS (clinical protocols)</td>
<td>1.6%</td>
</tr>
<tr>
<td>4</td>
<td>Closed loop med administration</td>
<td>3.7%</td>
</tr>
<tr>
<td>3</td>
<td>Clinical documentation (flow sheets), CDSS (error checking), inpatient PACS</td>
<td>25.0%</td>
</tr>
<tr>
<td>2</td>
<td>CDR, CMV, CDSS inference engine, document imaging</td>
<td>64.3%</td>
</tr>
<tr>
<td>1</td>
<td>Ancillaries - Lab, Rad, Pharmacy</td>
<td>80.6%</td>
</tr>
<tr>
<td>0</td>
<td>Basic platform, outpatient EMR</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
And Facing Outward...

EMR System Includes:
- Picture archiving and communications system (PACS)
- Computerized physician order entry (CPOE)
- Care delivery organization (CDO)
- Clinical data repository (CDR)
- Controlled medical vocabulary (CMV)
- Clinical decision support system (CDSS)
- Electronic medication administration record (eMAR)

Your Health Records

Health Systems
- Results Delivery
- Inquiry / Viewing
- Common Data Exchange
- Patient Enrollment
- eRefill / ePrescribing
- eOrdering
- Patient Portal
- Benefit Eligibility
- DHIN Smart / Eligibility card
- Incentive Program
- Decision Support
- Chronic Disease Mgmt.

Physicians
- Patient Enrollment
- Patient Portal
- Benefit Eligibility
- DHIN Smart / Eligibility card
- Chronic Disease Mgmt.

Consumers

Health Plans
- eRefill / ePrescribing
- eOrdering
- Patient Portal
- Claims / Payment Processing
- Benefit Eligibility
- Decision Support
- Chronic Disease Mgmt.
- Incentives & Performance Measurement

Research
- Data Collection
- Clinical Data Collection
- Admin Data Collection
- Bio-Terrorism Surveillance
- Bio-Medical Research

Public Health
- Chronic Disease Mgmt.
- Clinical Data Collection
- Clinical Data Mining
- Administrative Data Collection
- Administrative Data Mining

Other Providers
- Same as Physicians and/or Health Systems

Internet

Current & Future Applications
And Facing Outward…

Complexity Explosion:
- HITSP, IHE, ANSI Standards Explode
- Vendors, our own technologists* cannot keep-up
  - Vendor monogamy can help…
  - A rationalized, standardized regional, community
  - Dis-incentives to work together (make manageable)
  - Grow