Virtua Health
Process Driven Design

Pebble Conference
March 21, 2007

Mike Kotzen, COO, Voorhees Hospital
Tejas Gandi, Director Management Engineering
Stephanie Fendrick, Greenfield PM

Agenda

• Introduction to Virtua Health
  – Relationship with GE
  – History with Six Sigma
• Vision for New Campus
• Architect Selection Process
• Future State Planning Process
• Master Site Planning Process
• Management Engineering Role
Virtua Health….Today

- Four hospital system in Southern New Jersey
- Two Long Term Care Facilities
- Two Home Health Agencies
- Two Free Standing Surgical Centers
- Ambulatory Care - Camden
- Fitness Center
- 7000 employees + 1700 physicians
- 7,500 deliveries
- $840 million in revenues
- STAR Culture

Virtua Health: Where We Were?

- 1999: Merged corporate departments; integrated governance and management structures---Average performance.
- 01/01: CEO “We don’t want to be average…We want to be outstanding.”
- 03/01: Created a system wide cultural transformation: The STAR Initiative
- 10/01: Began the use of the GE Tool Kit to support cultural change
The Virtua STAR

Excellent service
Resource stewardship
Outstanding Patient Experience
Caring culture
Best people

Mission and Values
Strategy
Performance

It’s Great to Have a Philosophy . . . But We Need a Strategy !!

Current State:
STAR Commitment

Desired State:
STAR Performance

Six Sigma is part of our strategy on our journey through the maze
The Virtua Tool Kit

**Paths to Change**
- Strategic Decision
- Operational issue Requiring a Decision
- “Wisdom of the Group” Problem
- Eliminate Delay/Waste
- Eliminate Defects

- Change Acceleration
- WorkOut
- Lean
- Six Sigma

**Virtua Strategy Development Timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Comprehensive market assessment and infrastructure/facility recommendations</td>
</tr>
<tr>
<td>2003</td>
<td>Branding Strategy &amp; Bridge Plans</td>
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<tr>
<td>2004</td>
<td>POE Technology assessments and 10 year volume assessments Greenfield Guiding Principles</td>
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<tr>
<td>2005</td>
<td>Ambulatory Strategy</td>
</tr>
<tr>
<td>2006</td>
<td>Strategic campus planning</td>
</tr>
</tbody>
</table>
Overview of Current Voorhees Hospital

- 293 beds
- 24,000 Admissions
- 50,000 ED visits
- 5500 births
- 90%+ Typical Occupancy Levels

Drivers for new campus

- Replacement Hospital for Voorhees Hospital
  - No capacity
  - Inefficient and costly hospital infrastructure
  - Landlocked site
  - Consumer preferences
  - Digital Hospital infrastructure needs
  - New technology for diagnosis and treatment

- Implement Ambulatory strategy
  - Capture shift of IP to OP
  - Patient convenience
Campus Guiding Principles

• Provide a **digital model** to reduce errors, improve communication of vital information and drive efficiency.
• Develop a campus that is **flexible and versatile** with ability to maintain appropriate adjacencies with future expansion. Plan for long-term consolidation.
• Create a **feeling of destination** upon arrival to the campus.
• Create **high touch/high tech facilities** and services that integrate technology with the delivery of world class level service.
• Provide a full compliment of **“one-stop” services**.
• Create and maintain the **identity of specialty hospital** or centers (Women’s and Children’s Pavilion; Cancer Center)
• Provide clear **separation of outpatient and inpatient** services.
• Provide clear definition between **public vs. private** spaces.
• Provide a **healing, family centered environment**.
• **Maximize operational efficiency** throughout.

Digital Transformation – 3 Themes

1. **Information access everywhere** – scope, documentation expand, leads to…
2. **Streamline processes** for efficiency
3. **Establish new levels of process effectiveness**, robustness for better outcomes
With 3 Enablers to Safety, Quality

Paperless  Filmless  Wireless

Architect Selection Process
Early 2005
Architect Selection

- RFP process
- Criteria evaluated
- Scenario analysis
  - GE assessment
- Interview process
- Site Visits
- Final Selection

Lean workflow challenge presented to A/E candidates as screening criteria...

<table>
<thead>
<tr>
<th></th>
<th>Cardiology</th>
<th>Pulmonary</th>
<th>OB total</th>
<th>Firm 1</th>
<th>Firm 2</th>
<th>Firm 3</th>
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</thead>
<tbody>
<tr>
<td>2000 IP/yr</td>
<td>IP (40%)</td>
<td>OP (48%)</td>
<td>EP (12%)</td>
<td>10.8 Million Feet</td>
<td>6.6 Million Feet</td>
<td>12 Million Feet</td>
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<tr>
<td>1000 IP/yr</td>
<td>IP (15%)</td>
<td>OP (68%)</td>
<td>EP (17%)</td>
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<tr>
<td>OB total 2800 IP/yr</td>
<td>Induction (65%)</td>
<td>C-S (35%)</td>
<td>ALOS : 3.1 days</td>
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- 3 distinct options, option C best
- Best overall solution
- duplicate use of space issue
Future State Planning for the Greenfield campus

Stephanie Fendrick
Goal: Process driven design

Recommended Process:
• Research based:
  – Observation
  – Hypotheses
  – Testing & validation
• Emphasis on:
  – Optimal clinical pathways
  – Patient & family experience
  – Leveraging technology

Timeline for Future State Planning

<table>
<thead>
<tr>
<th>Month</th>
<th>Planning Step</th>
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<tbody>
<tr>
<td>March 2005</td>
<td>HGA on board</td>
</tr>
<tr>
<td>April - May</td>
<td>Determine planning process</td>
</tr>
<tr>
<td>June-Sept</td>
<td>Study patient and staff experience, current state mapping, technology roadmaps</td>
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<tr>
<td>Oct</td>
<td>Future State Operating Models – Research effort</td>
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<tr>
<td>Nov – Jan</td>
<td>Future State Planning Sessions</td>
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<tr>
<td>Jan 2006</td>
<td>Space Programming</td>
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<tr>
<td>February</td>
<td>Demand Analysis</td>
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<tr>
<td>March 2006</td>
<td>System Capital Plan Approved</td>
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Integration

Design Intelligence

Future State

Move In

Transformation

Peer to Peer Surveys
Patient Experience
Photo Journaling
High Level Flow
From-to Adjacency
ARENA Simulation
Technology Roadmaps
IT Enablers
Evidence Based Design
Safety Checklists
Leading Practice Research
Site Visits

Design

Input Deck

Pareto High Volume Pathways

Architectural Concepts

Service Line Discharges

V&C Obstetrics
V&C Neurosurgery
V&C Gynecology
Vascular Surgery
Urology
Thoracic Surgery
Substance Abuse
Pulmonary Medicine
Psychiatry
Plastic Surgery
Otolaryngology
Orthopedic Surgery
Ophthalmology
Oncology Hematol
Neurology
Neurosurgery
Infectious Disease
General Surgery
General Medicine
Gastroenterology
Endocrinology
Dermatology
Cardiology
Cardiac-OpenHeart
Cardiac/Neonatal
W&C Obstetrics
W&C Neonatal
W&C Gynecology
Vascular Surgery
Urology
Thoracic Surgery
Substance Abuse
Pulmonary Medicine
Psychiatry
Plastic Surgery
Otolaryngology
Orthopedic Surgery
Ophthalmology
Oncology Hematol
Neurology
Neurosurgery
Infectious Disease
General Surgery
General Medicine
Gastroenterology
Endocrinology
Dermatology
Cardiology
Cardiac-OpenHeart
Cardiac/Neonatal

Weighted Discharges

V&C Obstetrics
V&C Neurosurgery
V&C Gynecology
Vascular Surgery
Urology
Thoracic Surgery
Substance Abuse
Pulmonary Medicine
Psychiatry
Plastic Surgery
Otolaryngology
Orthopedic Surgery
Ophthalmology
Oncology Hematol
Neurology
Neurosurgery
Infectious Disease
General Surgery
General Medicine
Gastroenterology
Endocrinology
Dermatology
Cardiology
Cardiac-OpenHeart
Cardiac/Neonatal

0 1000 2000 3000 4000 5000 6000

0 1000 2000 3000 4000 5000 6000

Cardiac/Pacemaker
Cardiac-OpenHeart
Cardiac/Neonatal

Greenfield Workflow – A/E Input Deck
OB: Scheduled

Scheduled - Induction

- Entrance 5-10 min
- Registration
- 2nd Floor L&D 8-10 hrs
- Labor room 75%
- 2nd Floor Antepartum 25%
- 2-4 hrs
- C Section
- PACU
- 3/4 Fl Bed
- Discharged

Scheduled – C Section

- Entrance
- 2nd Floor L&D 5-10 min
- Registration
- Nurse Station 5 min
- Triage 1 hr
- 2nd Floor Antepartum
- 3/4 Fl Bed
- PACU
- C Section
- Discharged

POE/Technology Strategy

Summer 2004 – Virtua works with Sg2 to:

- Review current market assessment
- Conduct technology assessment and adoption profiles specific to each POE
  - Technology adoption curve
- Discuss inpatient and outpatient forecasts
- Project 10 year volume assessment by POE for system based upon:
  - Demographics
  - Consumerism
  - Payment and Economics
  - Technology and Care Delivery shift
Organizations Adopt Technologies at Different Rates

Innovators
- Adopt new technologies
- Research/develop new technologies

Early Adopters
- Lag in adoption of mature technologies

Consensus Adopters
- Adopt generally accepted technologies

Cautious Adopters
- Have outdated technologies/systems

Late Adopters
- Lag in adoption of new technologies

Women's POE Technology 2005-2010

<table>
<thead>
<tr>
<th>Imaging/Technology</th>
<th>Operational</th>
<th>Lab-Based Diagnostics</th>
<th>Environmental</th>
<th>Surgery</th>
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<td>2010</td>
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Photo journaling

- Staff perspective
- Patient perspective

Summer 2005

Major Themes expressed in photo journals

- Lack of storage
- Lack of privacy
- Lack of personal space for staff
- Poor waiting spaces
- Public and private spaces mixed
- Unscenic views for patients and staff
- Poor work spaces
No place for staff personal belongings

No public vs. private separation of space
Rooms with a View . . .

Future State Facility Operating Models

- Specimen Collection and Processing
- Medication Administration
- IP/OP Diagnostic Svcs
- Acuity Adaptable Rooms
- Food Services Delivery
- Patient Registration
- Equipment Management
- Digital Environment
- Central Sterile Supply
- Remote Monitoring
- Medical Library

Fall 2005
Future State Planning Sessions with HGA

3 rounds with 10 key areas to:

• Sharing observations
• Site visits/Research efforts around new facility designs
• Define future state flows
  – Directly impacted key information on space needs, key adjacencies, patient flows
  – Later tested with ME

Late Fall/Early Winter

Multiple Site Visits

• The Woodlands, Houston, Texas
• St. Clare’s, Weston, WI
• Northside Hospital, Atlanta, Georgia
• Baptist Memorial Hospital for Women, Memphis, TN
• Magee Women’s, Pittsburgh, PA
• Hackensack University Medical Center, Hackensack, NJ
• Morgan Stanley Children’s Hospital, NY, NY
• Mary Washington, VA
• MRMC, VA
• CentraCare, St. Cloud, MN
• St. Joseph’s, West Bend, WI
• Lancaster General, Lancaster, PA
• Good Samaritan Hospital, Reading, PA
• ChristianaCare, Newark, DE
• Lehigh Valley Hospital, city, PA
Community based Focus Groups

- Use of backwards imaging
- Recommendations
- Mock up evaluations
- Update sessions

NICU – A Case Study

- Photo journals illustrating concerns with current layout
- Focus group on past experience
- Future State mtgs discussed ways to organize unit – open, pods, single rooms
- Single Rooms “This will never work”
- Research on new level III NICU designs
  - Site visits- “I could not believe it until I saw it!”
- Focus Group input – privacy vs. security balance
MASTER SITE PLANNING

Mike Kotzen

The Original Models

MODEL A B C D E F
Model Evaluator Matrix

**Model A**

- [Image of Model A diagram]
Master Site Plan Drivers

- Two campus layout
  - Inpatient (north)
  - Outpatient (south)
- Integrated physician offices in the center
- Image of two inpatient hospital buildings
  - Women’s and Children’s
  - Adult
  - Separate identities & separate visitor entrances
- Efficiency of one hospital - one campus
  - Service and Patient Spine
- Outpatient / ambulatory patient convenience
- Flexibility for future growth
Blocking and Stacking Drivers

- Emergent Platform
  - Adult ED, Pediatric ED, OB Triage, & Dedicated Imaging
- Flexible Factory Space
  - Surgical / Interventional Platform
  - Separate LDR / NICU Floor
- Short-stay Hotel
  - Prep and Long-term Recovery, Observation Patients
  - Ambulatory Diagnostics
- Longer stay “condo” spaces
  - Separate and distinct bed towers
  - Orientation to wetlands
- Public vs. private spaces and flows
Role of Management Engineering

- Modeling for demand analysis
- MSP quantitative analysis
- Blocking and stacking recommendations
- Schematic design – application of LEAN
Sizing and Capacity Determination

- Traditional
  - Volume uniformly distributed
  - LOS - average
  - Capacity Needs: Product line (A+B+C+………)
- Virtua Health Approach
  - Consider seasonal patterns (anticipate peaks and valleys)
  - LOS – stochastic
  - Capacity Needs: Product line (A U B U C U……)
  - Simulation Approach

Arrivals (Admissions) by Month

Seasonal Trends in Patient Admissions
Sensitivity Analysis

- Answer the question: what mix of IP beds is most suitable to meet new demand

2012 Utilization Rates Using Current Bed Capacities

Current capacity cannot meet forecasted demand (high utilization rates result in exploding queues)

Analysis [cont’d]

• Utilization of IP Units

2012 Utilization Rates with Adjusted Bed Capacities

Forecasted patient volume growth results in a low utilization rate given bed capacities
Application of Quantitative Analysis to MSP

Where to Look

- The Pareto principle is used to prioritize tasks.
  - 20% of patient types, activities, problems, etc. make up 80% of the work effort, volume, or breakdowns
  - Identify the “Critical Few” that make up the lot
Virtua Reality

- Women’s and Children’s Services – 50%
  - Obstetrics (30%)
  - Women’s Health (15%)
  - Children’s (5%)
- All Others – 50%
  - Endo
  - Cardiac
  - Pulmonary
  - General Medicine
  - Geriatrics
  - Oncology
  - General Surgical
  - Neurology / Stroke

Math Works

- If we are to eliminate waste in transportation and motion, our master plans must consider
  - Staff cost
    - Direct patient needs
    - Indirect rounding
    - Milk Runs
  - Patient experience cost
    - To and from service
Valuing Proximity

- To evaluate the value of proximity we have seven key variables
  - Home base
  - Frequency of event
  - Services needed
  - Transportation type
  - Staff involved in transportation
  - Distance traveled to and from service
  - Speed of transport
  - Intangibles

Legends

Transportation Weights

- 6x
- 4x
- 3x
- 2x
- 1x

Red - Patient
Blue - Staff

From/To Calculation Box

- 96.00% Branch Percent
- 94.00% Aggregate Percent
- 4,794 Patient Volume
- 3 Transportation Type
- 14,382 Total Traffic

Critical Path Volumes

- Greater than 10,000
- Greater than 5,000
- Less than 5,000
Blocking and Stacking Drivers

- Management Engineering Analysis:
  - Travel distances
  - Ancillary deployment
  - New models – Equipment Depot
- Cost and Space Programming
  - Best fit scenarios
  - I to B

Schematic Design

- Application of LEAN:
- Updating process maps
- Spaghetti diagrams – current state
- Evaluation of alternatives
Using Lean to improve a process …

Lean: Making the Very Best use of the Resources We Have

Everywhere….All of the Time!
Lean: Schematic Design

- Pre-Schematic Session Work
  - Integration of any previous work
  - Shadow map high quantity tasks by staff
    - Activity description
    - Location accessed
    - Distance in motion
  - Swim Lanes
  - Space Relationships
  - Spaghetti Diagrams
  - Identify Lean concepts and opportunities in existing designs
  - Recommend ways to reduce waste in the system from people, process, technology and space perspective
Frequencies of Travel

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Number of Occurrences</th>
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<tbody>
<tr>
<td>26 - 40</td>
<td>10</td>
</tr>
<tr>
<td>11- 25</td>
<td>40</td>
</tr>
<tr>
<td>0 - 10</td>
<td>65</td>
</tr>
</tbody>
</table>

Overall Frequencies

Frequencies of movement are per Nurse per shift: 7 am to 7 pm
[Observed 06/21]

High Frequency Tasks carried-out by a Clinician during a regular shift

Nicu – Spaghetti Diagrams

Nurses
Total distance traveled by a Nurse is 2451 ft. per day per shift which is approximately 170 Miles per year, the same as walking from Philadelphia, PA to Long Island, NY.

Nurse Aides
Total distance traveled by Nurse Aide is 5410 ft. per day per shift which is approx. equal to 340 Miles per year, the same as walking from Philadelphia, PA to Pittsburgh, PA.

Nicu – Space Relationships

Clinician Pathway
Nurse Aide Pathway

Entrance

Nicu
I-Nicu
Pyxis / I-Nicu 2
Room
Nurse Station Supplies I-Nicu 1

Respirator Room
Supplies

Formal Room

Formal room
Nicu

Overall Frequencies

Nurse Station
Pain Supplies NICU
Formula Room

Formal room
Nicu

Respirator Room
Supplies

Nicu – Space Relationships

High Frequency Tasks carried-out by a Clinician during a regular shift

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Schematic Design: Evaluation

- **Process defines space not space defining process**
- Evaluate the activity
  - Is it value added?
  - Will technology enable, eliminate or improve the activity?
  - Can you change the sequence or route to complete the activity to reduce motion?
  - Can you bring the essentials tools and information within reach or closer to the care giver to reduce motion?
- Evaluate the alternative designs
  - Map future state
  - Spaghetti map flows
  - Recommend pros and cons of design

![Schematic Design: Evaluation Diagram](image-url)
DEPLOYMENT

• Information
• Supplies
• Staff
• Services

NICU – Future State Layout

Recommendations

- Nursing Station Location
  - Flip location of Nursing Station & Staff Toilet
  - Staff Toilet could be used by NICU moms? Possible to rename as Patient Toilet?

- Staff Toilet
  - Locate near Staff Lounge
  - Could the current location be used as scrubbing areas for families?
Concluding images

• Sedimentary materials anchor building to the ground.
• Lighter materials above express structure and technology.
• Glass facades reflect sky & landscape and maximize patient views.
• Strong horizontals minimize building’s impact on site.
Landscape flows through campus creating a variety of vistas for positive health and healing.
Intermittent courtyards aid patients in way-finding and a feeling of release.
The building acts as a filter and link between adjacent wet lands.

The building takes advantage of indirect light from the north while restricting the harsh southern sun.
The campus creates an intimate sensation through creation of plazas and gardens.
• Glass lanterns at ends of bed tower mark entries and family waiting areas.
• Canopy & signage extend from the building and grab the ring road to direct patients to the entrance.
• Courtyards orient patients as they travel through building.

Women & Children’s Entrance

• Views are directed toward gardens and limit views onto adjacent parking lots.
• Images of successful patients illustrate the importance of human interaction in Virtua’s process.
• Purposefully human scaled environment instills a sense of calm.

Women’s & Children’s Lobby
Captivates the senses through sight, scent, touch, and sound.
The curve of the bed tower embraces the landscape.
The postpartum is expressed with the accent material.

Emergency Department is separated from ambulance drop-off through landscaping.
Thoughtful and engaging through concealing and revealing.
Potential Pebble Projects

Access to Natural Light and Nature
Way finding with multiple entrances, distributed parking, separate visitor experiences.

Observation unit in ambulatory setting and impact on LOS

Single Room NICU
Inpatient unit design with decentralized charting stations, decentralized support areas,

Impact of floor design on travel distances – reduced walking and improved workflow – reduce time hunting and gathering

Private patient rooms with a patient controlled environment, family centered care environment, hospitality like setting, safety

Team hub design to promote care team environment. Impact of decisions with regarding to lighting and acoustics in this area.

Medication distribution process and impact on med errors with pharmacy deployed near patients and decentralized medication room and new technologies

Equipment Depot and impact on service response time& nursing efficiency

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Inpatient Unit Design

- Decentralized Charting Stations
- Decentralized Support
- New Technologies
- Strategically Located Hand-washing Stations

- Measurable Outcomes
  - Increase in patient safety / observation
  - Decrease in time “hunting & gathering”
  - Decrease in staff fatigue / errors
  - Decrease in “sneaker time”
  - Increase in communication
  - Increase in infection control ratings
Questions?

Thank you.