Predictive Analytics in Radiation Oncology

Michael Peters, MBA. R.T.(R)(T)
September 2014

USCANCERSPECIALIST, LLC
President/CEO of USCANCERSPECIALIST, LLC

20 total years of Oncology and Imaging Experience:
- 4 years direct Clinical Imaging and Radiation Therapy Care
- 11 in Management/Administrative Positions
- 5 years of Oncology and Imaging Service Line Consulting
AGENDA

- State of Healthcare
- Managing Throughput Modeling
- Breaking down the Process
- Case Scenarios
The State of Healthcare
Meeting the Changing Market Demands within the Healthcare Environment

- Improve Quality and Safety
- Optimize Resource Utilization
- Evidence-based Outcomes
- Reduce Costs (Efficiency)
- Maximize Revenue & ROI

Cost Effective, High Quality Patient-Centric Care
Healthcare Inefficiency in the US

- United States health care system is the most expensive in the world.

- U.S. underperforms relative to other countries on most dimensions of performance. (AUS, CAN, FRA, GER, NETH, NZ, NOR, SWE, SWIZ, UK)

- U.S. is last or near last on dimensions of access, efficiency, equity, quality and health outcomes.

- Affordable Care Act is increasing the number of Americans with coverage and access to care, but still lacks in Universal Health Insurance and accessibility of care.
# A Personal Perspective: Radiation Oncology Challenges within Healthcare

<table>
<thead>
<tr>
<th>Staffing</th>
<th>Scheduling</th>
<th>Technology</th>
<th>Patient, Staff, Physician Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Temporary Staffing</td>
<td>• Seasonal Fluctuation,</td>
<td>• New Technology Justification</td>
<td>• Patient Wait Times</td>
</tr>
<tr>
<td>• Daily Patient Volume fluctuation</td>
<td>• Linac Availability</td>
<td>• New Technology Adoption (SRS/ SBRT, PET/CT, HDR-Mammosite©)</td>
<td>• Staff Turnover</td>
</tr>
<tr>
<td>• Maternity/Paternity Leave</td>
<td>• Time from Referral to Consult</td>
<td></td>
<td>• Physician Referrals</td>
</tr>
<tr>
<td>• Medical Leave Mergers/ Consolidation</td>
<td>• Time from Simulation to Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Physics QA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which way do we move forward?

**Patient Flow**
How do I determine the right type of staff, the optimum schedule, and the correct staffing requirements for optimized patient flow?

**Workflow Process Improvement Initiatives**
Which one(s) should be implemented and how?

**Facility/Project Planning**
Do we have to expand or just re-design our existing facilities to meet demand and capacity issues?

**New Technology Evaluation and Implementation**
Do we have the right technology to meet the changing physician and patient demand for care?
What Value Added Services Provide Value

◆ Have access to high value Clinical and Professional Consulting services, specializing in Oncology specific Data Analytics.

◆ Have access to detailed customized analytic reports that offer oncology-specific planning and management capability with the ability to offer a solution that supports capacity and scenario planning.
Value of Predictive Modeling Software

- Enables hospital administrators to:
  - Benchmark workflow, standardization
  - Perform forward predictive planning of resources
  - Budget for patient treatment capacity

  *All without affecting the operational service*

- Allows for more informed decisions about cancer care for the benefit of patients – saving everyone involved valuable time and money
Managing the Challenges of Predictive Analytics
Improving Performance and Patient Satisfaction through Predictive Analytics

- Effectively utilizing Computer Modeling to account for "what if" questions regarding various scenarios of Cost, Capacity, Demand, and Workflow.

- Effectively Interpreting Utilization and Efficiency data to collectively derive an operational plan to improve Patient Satisfaction.
Shaping Efficiency and Utilization

Actual Patient Throughput*

Efficiency = \frac{\text{Effectiveness of Service Capacity}}{\text{Actual Patient Throughput}^*}

Actual Patient Throughput*

Utilization = \frac{\text{Designed Service Capacity}}{\text{Actual Patient Throughput}^*}

*Daily, Monthly, Annually
Revealing the Bottlenecks and Constraints

DEMAND/CAPACITY = THROUGHPUT
Providing Effective Capacity Planning

1. **An Understanding of Current Services**
   1. *How resources are utilized*
   2. *Cost of resource utilization per patient*

2. **Experiment with alternatives**
   1. *Model the effects of introducing a new Linac, increase of patient volume, staffing level changes*

3. **Strategize for the Future**
   1. *New satellite facility, consolidation of services, Program Center of Excellence*
Benefit of Predictive Analytics

- Improve patient flow
- Track highly variable arrival patterns
- Reducing long delays, door-to-provider

- Compare and evaluate similar technologies
- Analyze implementation strategies
- Develop technology integration plans

- Capacity analysis
- Optimized room and resource utilization
- Analyze movement of patients through the department

- Predicting effects of absenteeism
- High level capacity demand modeling and analysis
- Cost effective staff competency improvements
Defining the Process
The Process

1. *Create* a Model of the current environment (Baseline)

2. *Understand*/ *Evaluate* areas for opportunity (Review Baseline)

3. *Simulate* new scenarios (Simulation)

4. *Plan* for the future (Evaluation)
Breaking Down the Door on Big Data

Radical Palliative Diagnosis Overhead Salaries/Wages Overtime Wait times Tx Commencement Utilization
Creating the Baseline: Data Requirements

**Data In**

**Patient Distribution**
- Cancer type
- Treatment Type
- Palliative
- Radical

**Resources**
- Competencies/Capabilities
- Vacations
- Working Hours
- Technology (Linacs, CT, Planning)

**Facility Parameters**
- Opening/Closing Times
- Holidays
- Scheduled Maintenance
- Seasonal Variance

**Costs**
- Overhead (Utilities, Supplies, Consumables, i.e.)
- Depreciated equipment
- Service contracts

**Value Out**
Creating the Baseline: Process Mapping

- Representation of Patient and Staff workflow
- Represent the delivery of RT (technique or protocol) to a patient.
- Built using components representing processes (planning, treatment delivery).
- Comprised of tasks (time based) performed by resources in the department.
- Establishes detailed level of operational efficiency.
Providing Value in Throughput Modeling: Case Scenarios
Case 1: Acquisition/Consolidation

**Problem Statement:**
Health System is considering an acquisition of a freestanding center. Should the health system maintain or consolidate services?

**Hypothesis:**
Overall sense within the health system is no need to keep acquired center open due to low volume and antiquated technology.

**Objective:**
Determine the costs and financial savings that consolidation would provide, while maintaining efficient throughput as to not impact patient wait times and staff/physician utilization.
Breaking Down the Feasibility

**Avg Patients Per Year**

<table>
<thead>
<tr>
<th></th>
<th>Consolidation</th>
<th>Freestanding</th>
<th>Main</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freestanding</td>
<td>224</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>701</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consolidation</td>
<td>925</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Overhead Costs per Year**

<table>
<thead>
<tr>
<th></th>
<th>Consolidation</th>
<th>Freestanding</th>
<th>Main</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freestanding</td>
<td>870693</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>1994359</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consolidation</td>
<td>2027632</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

18 Total Staff Members (5 RTT’s)
- 701 New/Treated RO Patients
- 8am-6pm Operating Hours
- Financial Overhead $2M

7 Total Staff Members (2.5 RTT’s)
- 225 New/Treated RO Patients
- 8am-5pm Operating Hours
- Financial Overhead $870k
KEY POINTS:
• Main Center Total Costs as part of Consolidation increased only $33k
• No Increase of Staff or Resources to Treat Additional patients
• Freestanding alone Total Costs for Same Pt. Load at $870k
# Demand on Resources (Linac)

## Patient Throughput per Linac

<table>
<thead>
<tr>
<th>Day</th>
<th>Main L1</th>
<th>Consolidation</th>
<th>Main L2</th>
<th>Consolidation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>20.91836735</td>
<td>29.26530612</td>
<td>24.14285714</td>
<td>29.24489796</td>
</tr>
<tr>
<td>Tuesday</td>
<td>21.23076923</td>
<td>30.5</td>
<td>25.86538462</td>
<td>30.40384615</td>
</tr>
<tr>
<td>Wednesday</td>
<td>20.57142857</td>
<td>30.18367347</td>
<td>25.57142857</td>
<td>30.12244898</td>
</tr>
<tr>
<td>Thursday</td>
<td>21.49056604</td>
<td>30.01886792</td>
<td>25.24528302</td>
<td>30.26415094</td>
</tr>
<tr>
<td>Friday</td>
<td>21.14</td>
<td>31.04</td>
<td>26</td>
<td>30.82</td>
</tr>
</tbody>
</table>
Consolidation of Services Utilization Impact

Radiation Therapist Utilization

**Main Center**

<table>
<thead>
<tr>
<th>Day</th>
<th>OverTime</th>
<th>Modifiers</th>
<th>Unutilised</th>
<th>Utilised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>18.67%</td>
<td>60.36%</td>
<td>64.04%</td>
<td>61.86%</td>
</tr>
<tr>
<td>Tuesday</td>
<td>21%</td>
<td>61.20%</td>
<td>63.86%</td>
<td>64.04%</td>
</tr>
<tr>
<td>Wednesday</td>
<td>21%</td>
<td>61.86%</td>
<td>62.71%</td>
<td>62.71%</td>
</tr>
<tr>
<td>Thursday</td>
<td>15%</td>
<td>61.20%</td>
<td>63.86%</td>
<td>63.86%</td>
</tr>
<tr>
<td>Friday</td>
<td>15%</td>
<td>61.20%</td>
<td>63.86%</td>
<td>63.86%</td>
</tr>
</tbody>
</table>

**Main + Pt. Consolidation**

<table>
<thead>
<tr>
<th>Day</th>
<th>OverTime</th>
<th>Modifiers</th>
<th>Unutilised</th>
<th>Utilised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>5%</td>
<td>68%</td>
<td>72%</td>
<td>71%</td>
</tr>
<tr>
<td>Tuesday</td>
<td>6%</td>
<td>71%</td>
<td>72%</td>
<td>71%</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6%</td>
<td>70%</td>
<td>71%</td>
<td>70%</td>
</tr>
<tr>
<td>Thursday</td>
<td>6%</td>
<td>71%</td>
<td>70%</td>
<td>71%</td>
</tr>
<tr>
<td>Friday</td>
<td>6%</td>
<td>70%</td>
<td>71%</td>
<td>70%</td>
</tr>
</tbody>
</table>
True Measure of Efficiency & Quality

Consolidation
Main Center
Freestanding

Consolidation
Main Center
Freestanding

Increase Operating Hours
Increase Resources (Linac and Staff)
Decrease Days from Referral to Tx

Average Days To Treat

Consolidation: 20
Main Center: 13
Freestanding: 12
Conclusion:

1. Limited financial impact to Main Center for Consolidation of Services
2. Significant financial savings associated with closing freestanding center.
3. Utilization of RTT’s above threshold and Linac Utilization change minimal.
4. Increase of wait time (days) from Referral to Tx with Consolidation.
Case Example #2

**Problem Statement:**
Center has experienced increased overhead costs and increased Patient wait times for Breast Cancer Patients, in comparison to other disease sites.

**Hypothesis:**
Non-conformity in the methods that physicians treat Breast Cancer Patients within our center has led to the increases in costs and wait times. (Seven Different Breast Care Pathways)

**Objective:**
Determine the cost difference, staff utilization, and patient wait times for breast Treatment based upon the different methods our physicians treat breast cancer patients within our center.
What is this Costing us?

Overhead cost per patient

- On a per patient basis, Prone Breast Tx accounts for the highest associated cost.
- Poses a clinical question of interest: Does Prone Breast offer a better Quality Outcome?

Cost breakdown per disease site (breast)

- Breast accounts for 25% of the total 701 New Patients seen in this center.
- Respectively it also accounts for 27% of the Total associated department Costs, specifically in Staff Utilization Costs.
What is the Staff time Utilization?

Total Time per Competency/Capability per Pathway

- Administration
- Linac
- Treatment
- Physics planning
- Pre-treatment Eqmt
- Imaging
- Immobilisation
- Oncology

Time in minutes

- 15fxs
- IMRT
- 20fxs
- SBRT
- Prone
- Prone
- Prone
- HDR

0 100 200 300 400
What is our Referral to Tx time?

Average time (days) per pathway component
By Patient classification

Total Time (days) from Referral to Treatment
How does Breast delay rank?

DISTRIBUTION OF DELAYS FOR TASK COMMENCEMENT

- Breast has the greatest percentage of patients 24% waiting at least 1 hr for a Task to start. Indicating lack of resources to complete associated tasks.

- Lung has the greatest % of patients waiting under a 1/2 hr demonstrating better efficiency.

- Not a daily basis wait time, but the percent of patients that will expect to see a wait time of that length during at least once during their care cycle.
## Conclusion:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Prone Breast Tx Care Path is the least cost effective model of care.</td>
</tr>
<tr>
<td>2</td>
<td>• Breast Tx accounts for 27% of Total department costs and 25% of Total patients.</td>
</tr>
<tr>
<td>3</td>
<td>• Breast Tx takes an average of 16 days to start Tx, 4 days longer than any other disease Tx path.</td>
</tr>
<tr>
<td>4</td>
<td>• Breast Tx Care Paths have the highest percentage of patients waiting at least 1hr at any given point for a Task completion.</td>
</tr>
</tbody>
</table>
FINAL RECAP
A Recap of the Value of Predictive Analytics

- Baseline modeling of operations and financials.
- Reduction in business and financial risks using real life models and simulations.
- Quantitative data for budget justification for staffing, equipment and facilities.
- Ability to Benchmark Nationally with centers of same size and demographics.
- Increase businesses efficiencies, productivity and profitability.
- Standardization to deliver best practices amongst centers.
Contact Information: uscancerspecialist@gmail.com