GETTING IT RIGHT THE FIRST TIME: MOVING CHECKS UPSTREAM IN THE TREATMENT PLANNING PROCESS

Stephanie A. Parker, MS, DABR, CSSGB, FAAPM

Atrium Health Wake Forest Baptist High Point Medical Center, High Point, NC

ANONYMOUS SESSION SURVEY (<5 MINUTES)

https://bit.ly/TxPlan1

CONFLICTS OF INTEREST

- None

DISCLOSURES

- Member of AAPM WGPE
- Member of TG275

LEARNING OBJECTIVES

Gain insight into the most common error origination and detection workflow steps in the treatment planning process

Learn about applicable concepts from manufacturing quality management

Be introduced to the concept of Time Driven Activity Based Costing (TDABC)

Lean about current recommendations related to upstream plan checks

OUTLINE

- Traditional Plan Check Process
- Treatment Planning Error Origination and Detection Locations
- Manufacturing Quality Management
- Cost of Quality
- Potential Financial Affects
- Current Recommendations for Upstream Plan Checks
- Where do we go from here?

TRADITIONAL PLAN CHECK PROCESS

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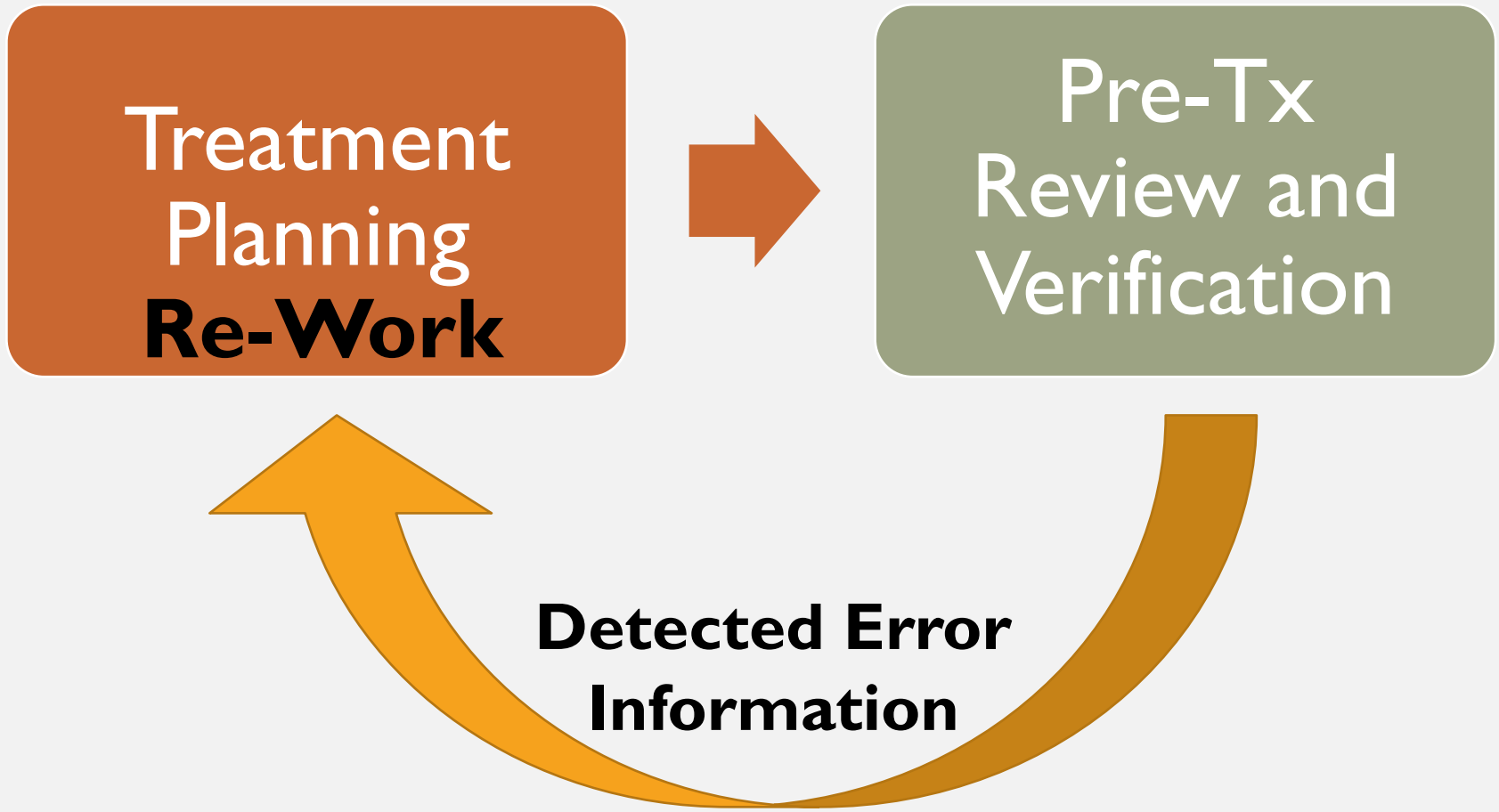
Ford, E.C., Fong de Los Santos, L., Pawlicki, T., Sutlief, S. and Dunscombe, P. (2012), Consensus recommendations for incident learning database structures in radiation oncology. Med. Phys., 39: 7272-7290. https://doi.org/10.1118/1.4764914

TRADITIONAL PLAN CHECK PROCESS



TRADITIONAL PLAN CHECK PROCESS

Treatment Planning → Pre-Tx Review and Verification

TREATMENT PLANNING ERROR ORIGINATION AND DETECTION LOCATIONS

https://www.astro.org/ASTRO/media/ASTRO/Patient%20Care%20and%20Research/PDFs/ROILS_2021_Q4.pdf

TREATMENT PLANNING ERROR ORIGINATION AND DETECTION LOCATIONS

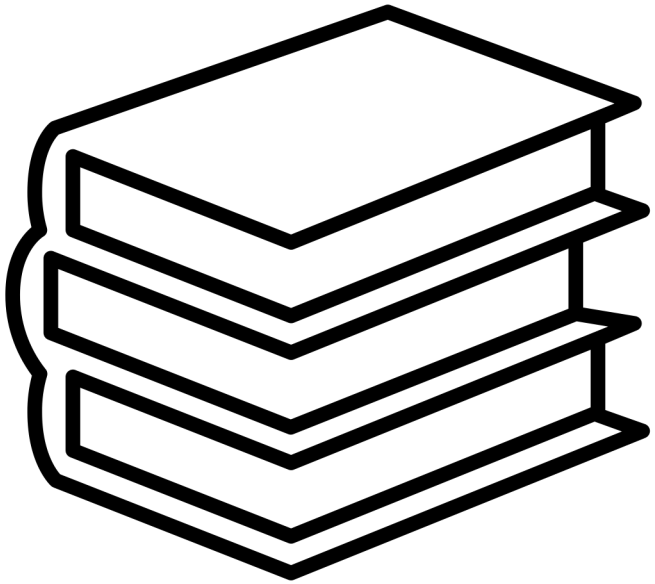
METRIC	AGGREGATE HISTORICAL SUM
Total Number Of Events	**21108**
Therapeutic Radiation Incident Other Safety Incident Near Miss Unsafe Condition Operational/Process Improvement	**2700** **2573** **4097** **3458** **8280**
Most Commonly Identified Workflow Step Where Event Occurred	**Treatment Planning** **30%** **(6371/21108)**
Most Commonly Identified Workflow Step Where Event was Discovered	**Treatment Delivery Including Imaging** **30%** **(6271/21108)**

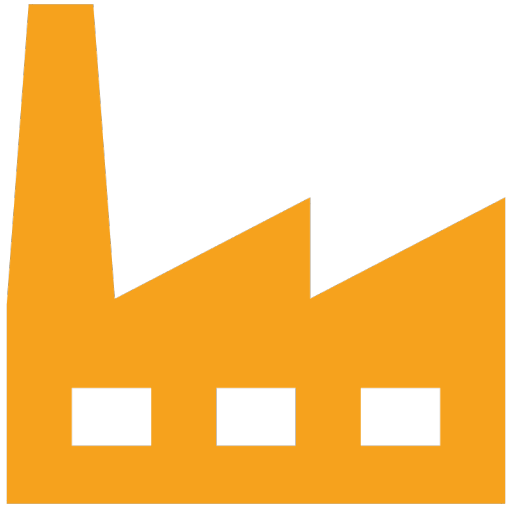
https://www.astro.org/ASTRO/media/ASTRO/Patient%20Care%20and%20Research/PDFs/ROILS_2021_Q4.pdf

TREATMENT PLANNING ERROR ORIGINATION AND DETECTION LOCATIONS

RO-ILS Data Shows:

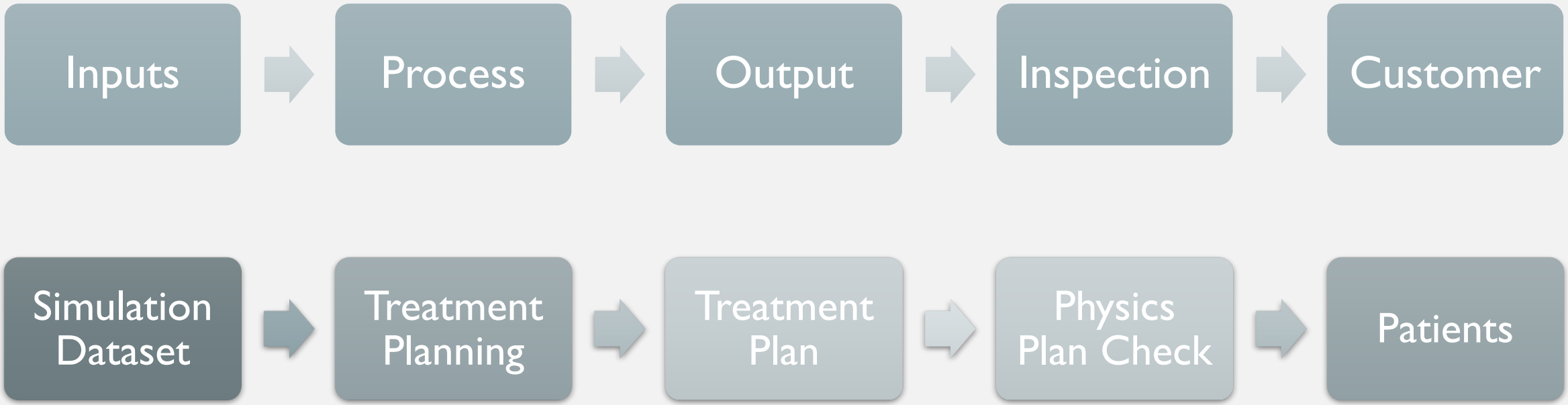
- Large separation between error origination and detection
- Missed opportunities to detect errors before treatment delivery





MANUFACTURING QUALITY MANAGEMENT

TREATMENT PLANNING AS MANUFACTURING PROCESS



MANUFACTURING QUALITY MANAGEMENT

Frederick W. Taylor

- Scientific Management (Taylorism)
- Late 1800's

MANUFACTURING QUALITY MANAGEMENT

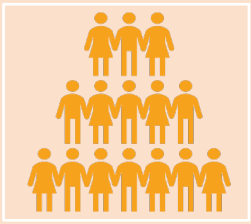
SCIENTIFIC MANAGEMENT (TAYLORISM)

Focus on Efficiency

Dramatically Increased Productivity

Quality in Hands of Inspectors

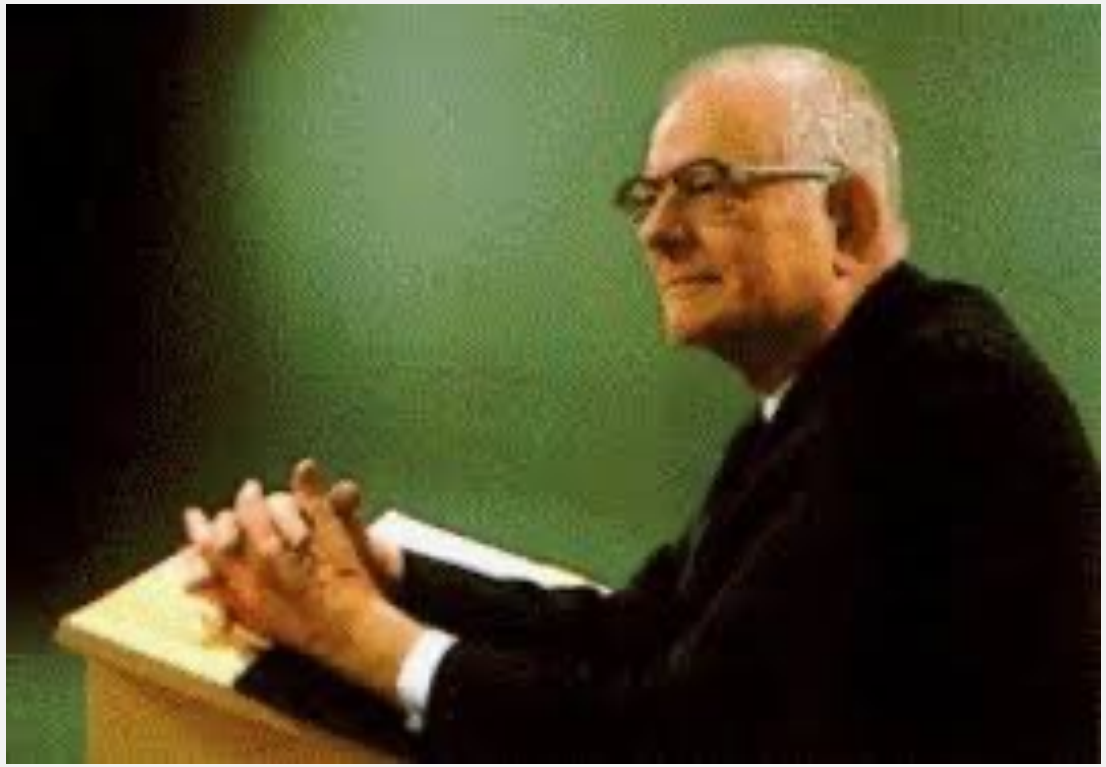
Quality Eroded



Employed hundreds of inspectors

Excess Scrap

MANUFACTURING QUALITY MANAGEMENT



W. Edwards Deming

http://www.fda.gov/oc/initiatives/criticalpath/stanski/stanski.html

- 1950's - Post WWII Japan
  - Deming's 14 Points
  - Point 3: Understand Inspection
    - Does not add value
    - Rework expensive
    - Encourages Defects by Passing the Buck
  - Quality should be in the hands of the workers

MANUFACTURING QUALITY MANAGEMENT

Shigeo Shingo

http://www.shingoprize.org/about

- 1960's – Japanese Industrial Engineer
- Zero Quality Control (ZQC)
  - Stop Errors at or Very Close to Source
  - Simple & Inexpensive Processes
    - Successive Checking
      - Checking prior work before continuing
    - Self Checking
      - Operators assess own work

ELEMENTS OF ZERO QUALITY CONTROL

1. Source Inspection to catch errors before they become defects
2. 100% inspection to check all products, not just a sample
3. Provides immediate feedback, which shortens time for corrective action
4. Because smart people do make mistakes, uses Poka-Yoke (mistake-proofing) devices for checking process steps

MANUFACTURING QUALITY MANAGEMENT

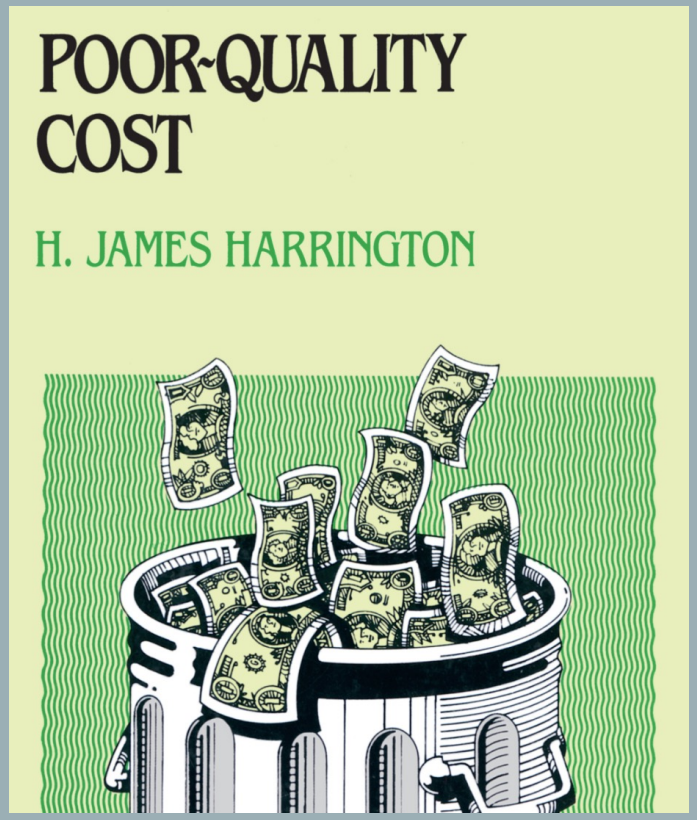
https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter4/4_vclearance.htm

COST OF QUALITY

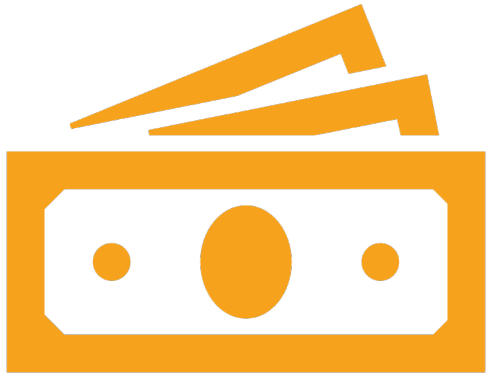
QUALITY COST CLASSIFICATION

Prevention Costs	Appraisal Costs	Internal Failure Costs	External Failure Costs
Doing it Right the First Time	Checking that it was Done Right	Errors that are Caught During Appraisal	Errors that Reach the Customer
• Quality Planning • Process Control • Information Systems • Training	• Inspection • Process Measurement	• Scrap and Rework • Corrective Action	• Customer Dissatisfaction • Administrative • Liability

PREVENTIVE COSTS



- Not really a cost, but an investment in the future
- Sometimes referred to as "cost-avoidance investment"
- Preventive activities:
  - Have a positive effect on ability to do the job right every time
  - Improve first-time yield
- Prevention costs early in product cycle
  - Biggest payback
  - Least expensive to correct problems



POTENTIAL FINANCIAL AFFECTS

Time Driven Activity Based Costing (TDABC)

TIME DRIVEN ACTIVITY BASED COSTING (TDABC)

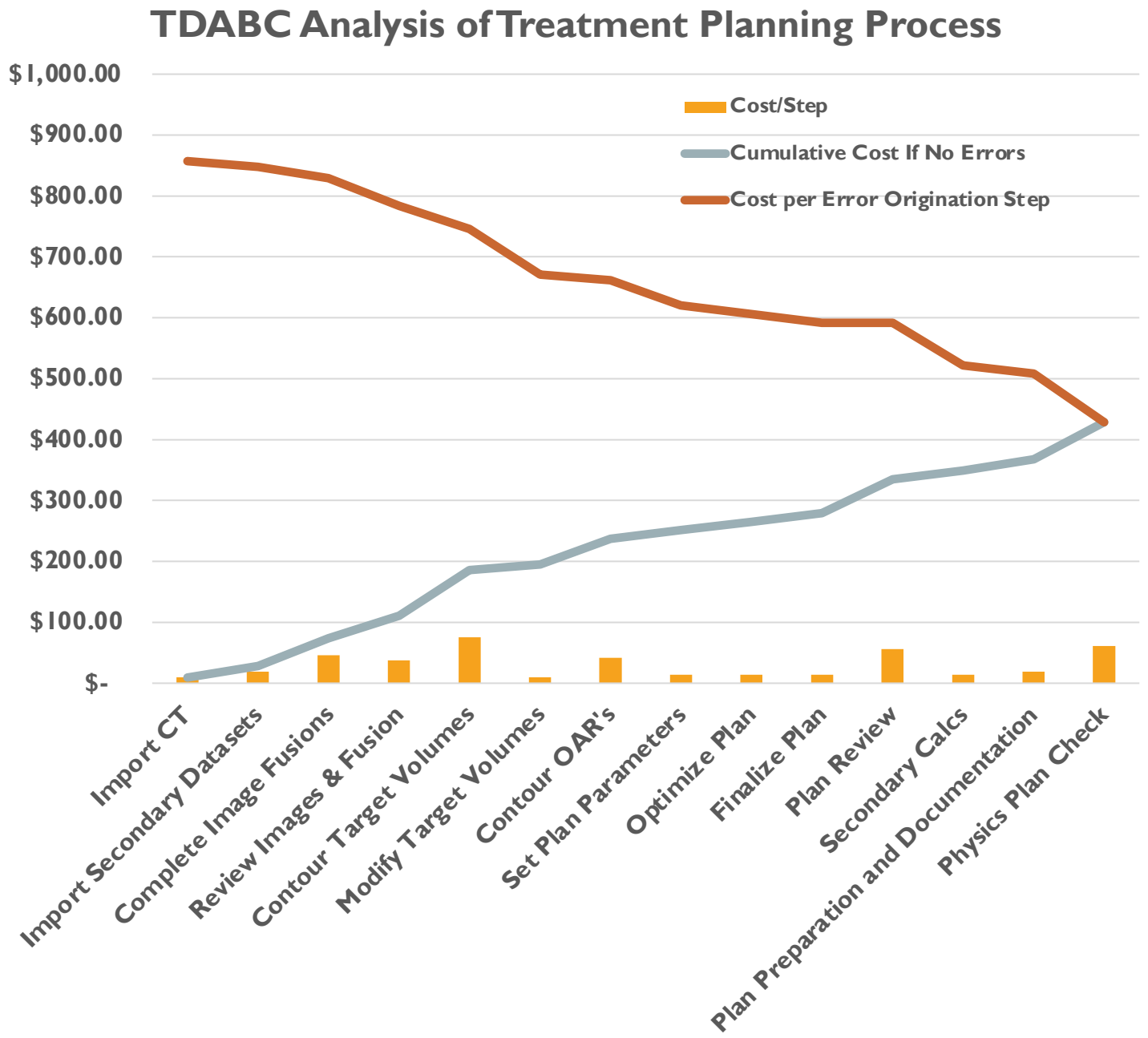
A “methodology that calculates the costs of healthcare resources consumed as a patient moves along a care process .”

Martin JA, Mayhew CR, Morris AJ, Bader AM, Tsai MH, Urman RD. Using Time-Driven Activity-Based Costing as a Key Component of the Value Platform: A Pilot Analysis of Colonoscopy, Aortic Valve Replacement and Carpal Tunnel Release Procedures. J Clin Med Res. 2018 Apr;10(4):314-320. doi: 10.14740/jocmr3350w. Epub 2018 Feb 18. PMID: 29511420; PMCID: PMC5827916.

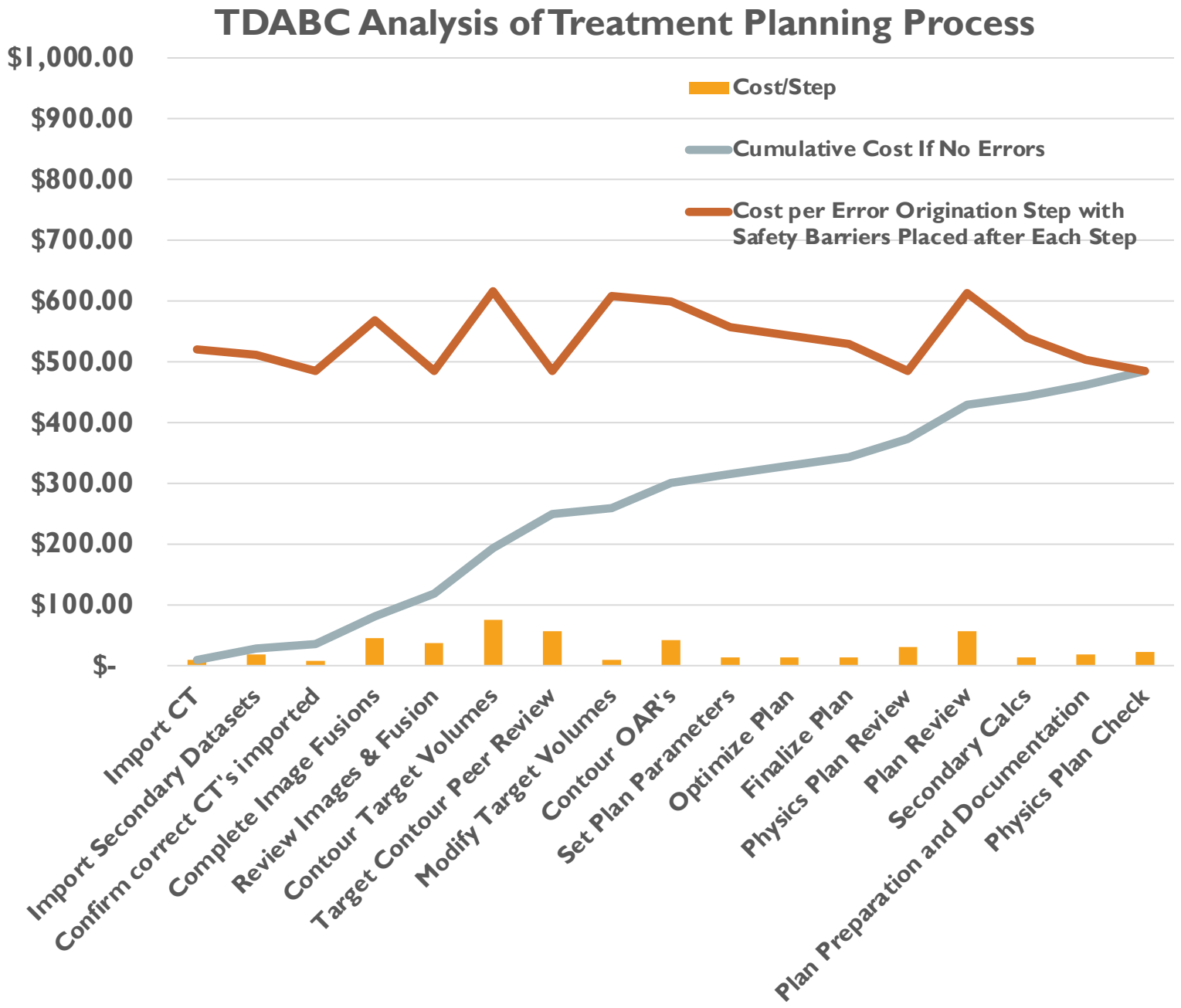
Process Step	Responsible Personnel	Estimated Time to Complete Step (minutes)
Import CT	CMD	10
Import Secondary Datasets	CMD	20
Complete Image Fusions	MP	20
Review Images & Fusion	RO	10
Contour Target Volumes	RO	20
Modify Target Volumes	CMD	10
Contour OAR's	CMD	45
Set Plan Parameters	CMD	15
Optimize Plan	CMD	15
Finalize Plan	CMD	15
Plan Review	RO	15
Secondary Calcs	CMD	15
Plan Preparation and Documentation	CMD	20
Physics Plan Check	MP	40

TIME DRIVEN ACTIVITY BASED COSTING (TDABC)

TIME DRIVEN ACTIVITY BASED COSTING (TDABC)



TIME DRIVEN ACTIVITY BASED COSTING (TDABC)



CURRENT RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management

M. Saiful Huq, Benedick A. Fraass, Peter B. Dunscombe, John P. Gibbons Jr., Geoffrey S. Ibbott, Arno J. Mundt, Sasa Mutic, Jatinder R. Palta, Frank Rath, Bruce R. Thomadsen, Jeffrey F. Williamson, Ellen D. Yorke

2016

Quality Contol (QC)

vs.

Quality Assurance (QA)

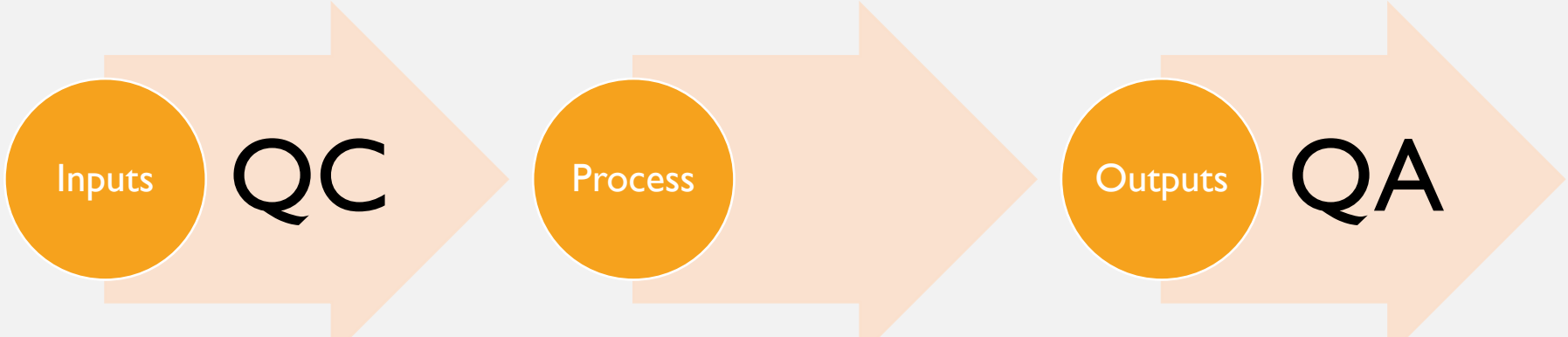
RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS TG100

QUALITY CONTROL (QC) EFFORTS

- Goal: Assures inputs are correct
- Detected errors result in less wasted effort

QUALITY ASSURANCE (QA) EFFORTS

- Goal: Assures outputs are correct
- Detected errors:
  - Determine cause
  - Correction of error
  - Repeat process with corrected input



RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2020

Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275

Key Recommendation:

"Practices should work to incorporate physics reviews as early in the workflow as possible and not rely solely on review at the end-of-treatment planning"

Ford, E., Conroy, L., Dong, L., de Los Santos, L.F., Greener, A., Gwe-Ya Kim, G., Johnson, J., Johnson, P., Mechalakos, J.G., Napolitano, B., Parker, S., Schofield, D., Smith, K., Yorke, E. and Wells, M. (2020), Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275. Med. Phys., 47: e236-e272. https://doi.org/10.1002/mp.14030

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2020 **Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275**

Advantages:

- "issues may be more easily identified
- changes may be more easily executed if the work is not yet complete
- wasted effort and rework may be avoided (which translates into time and cost savings)
- early review may allow for several shorter, more focused checklists rather than one very long checklist late in the workflow"

Ford, E., Conroy, L., Dong, L., de Los Santos, L.F., Greener, A., Gwe-Ya Kim, G., Johnson, J., Johnson, P., Mechalakos, J.G., Napolitano, B., Parker, S., Schofield, D., Smith, K., Yorke, E. and Wells, M. (2020), Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275. Med. Phys., 47: e236-e272. https://doi.org/10.1002/mp.14030

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2021 **Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy**

"recommend that the planner conduct a self-check during planning or after the plan is completed"

Xia, P, Sintay, BJ, Colussi, VC, et al. Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy. *J Appl Clin Med Phys*. 2021; 22: 4–19. https://doi.org/10.1002/acm2.13366

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2021 **Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy**

"each institution should perform independent assessments of the best methods to catch errors upstream and to avoid treatment delays. Medical physicists should participate in designing an optimal workflow that can catch errors as early as possible in the treatment planning process."

Xia, P, Sintay, BJ, Colussi, VC, et al. Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy. *J Appl Clin Med Phys*. 2021; 22: 4–19. https://doi.org/10.1002/acm2.13366

WHERE DO WE GO FROM HERE?

QUALITY MANAGEMENT IN RADIATION ONCOLOGY

- Standardization
- Automation
- Safety Barriers Placement Optimization

STANDARDIZATION

- Reduces Variation and Random Error
- Pre-requisite to Automation

STANDARDIZATION

Standardizing dose prescriptions: An ASTRO white paper

Suzanne B. Evans MD, MPH [a,*], Benedick A. Fraass PhD [b], Paula Berner CMD, FAAMD [c], Kevin S. Collins PhD, RT(R)(T), CMD [d], Teamour Nurushev PhD [e], Michael J. O'Neill MD [f], Jing Zeng MD [g], Lawrence B. Marks MD [h]

practical radiation oncology
pro
www.practicalradonc.org

Practical Radiation Oncology (2016) 6, e369–e381

AAPM Task Group 263: Tackling Standardization of Nomenclature for Radiation Therapy

C. Mayo, J.M. Moran, Y. Xiao, W.R. Bosch, M.M. Matuszak, L.B. Marks, R.C. Miller, Q.R.J. Wu, T.I. Yock, R. Popple, T.R. McNutt, N. Brown, A. Molineu, T.G. Purdie, E.D. Yorke, L. Santanam, P. Gabriel, J.M. Michalski, J. Moore, S. Richardson, R.A.C. Siochi, M. Napolitano, M. Feng, T. Fitzgerald, K. Ulin, W.F.A.R. Verbakel, M.S.U. Siddiqui, M.K. Martel, Y. Archambault, T. Morgas, J. Purcy, J.A. Adams, M. Ladra, B. Lansing, R. Ruo, A. Fogliata, C. Hurkmans

International Journal of Radiation Oncology biology • physics
Official Journal of the American Society for Radiation Oncology
ASTRO

Volume 93, Issue 3, Supplement, Pages E383–E384

AUTOMATION

Driven by a need to increase efficiency

Time is valuable

Some items simply more effective to check using automated methods

SAFETY BARRIERS PLACEMENT OPTIMIZATION

- Need to pay attention to location of automated safety barriers
- Design safety into the process
- Put barrier within or immediately following error prone process step
- Put safety into the hands of the planner
- Reduce “scrap” or re-work
- Evaluate barrier types for efficiency and effectiveness

HOW DO I IMPLEMENT THESE CONCEPTS IN MY CLINIC?

THREE EXAMPLES OF EXPERIENCE WITH UPSTREAM QA STEPS

- Scripting and Automation for Efficient and Effective Chart Checks in a Pinnacle/Mosaiq Environment
  - Dr. Badal Juneja
  - MD Anderson Cancer Center at Cooper
- Lessons Learned From Upstream Physics Peer Review of Plan Quality With the Eclipse Treatment Planning System
  - Dr. Grace Kim
  - University of California at San Diego
- Experience With Upstream Plan Quality Checks Using the Raystation Treatment Planning System
  - Dr. Leigh Rankine
  - University of North Carolina at Chapel Hill

WHAT IF I DON'T HAVE THE RESOURCES TO ESTABLISH THESE METHODS?

Some vendor solutions are available

- Not a current option for all treatment planning systems
- Encourage vendors to include your TPS

Justify need to administration

- Use methods discussed in this talk
- Justify need to support training for clinical physicists
- Justify need for vendor solutions if available

THE END

REFERENCES & RECOMMENDED READING

- ACR–AAPM TECHNICAL STANDARD FOR THE PERFORMANCE OF RADIATION ONCOLOGY PHYSICS FOR EXTERNAL BEAM THERAPY
- Arnold, R. and Wade, J. A Definition of Systems Thinking: A Systems Approach, *Procedia Computer Science*. 44 (2015) 669 – 678
- Clarity PSO, AAPM and ASTRO, ROILS: Radiation Oncology Incident Learning System Q4 2021 Quaterly Report,https://www.astro.org/ASTRO/media/ASTRO/Patient%20Care%20and%20Research/PDFs/ROILS_2021_Q4.pdf
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