

RISK ASSESSMENT FOR PHYSICS PLAN REVIEW

STEPHANIE A. PARKER, MS, DABR
NOVANT HEALTH GREATER WINSTON-SALEM MARKET, NORTH CAROLINA



CONFLICTS OF INTEREST

- None

DISCLOSURES

- Member of TG275

OBJECTIVES

- To provide an introduction and overview of TG-275
- To show how physics plan and chart checks relate to error management
- To demonstrate the use of TG-100 Methodology to assess physics plan and chart check processes
- To share TG-275 members' experience during FMEA process

OUTLINE

- Background
- The Team
- Charge and Scope of TG-275
- Crew Resource Management
- TG-275 Initial Tasks
- Current Guidelines
- TG-275 Risk Assessment (FMEA) Experience to Date
- Work in Progress
- Summary

BACKGROUND

- TG-275: Strategies for Effective Physics Plan and Chart Review in Radiation Therapy
- September 2014
 - Eric Ford started Recruiting Members
 - Preliminary Meeting
- December 2014
 - Proposal Submitted
 - Kick-Off Meeting
- April 2015
 - Approval by Therapy Physics Committee
 - Approval by Science Council
 - Assigned TG Number

AAPM COMMITTEE TREE

Work Group on Prevention of Errors in Radiation Oncology

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Bylaws: Not Referenced. **Rules:** Not Referenced.

Approved Date(s) Start: 1/20/2005
End: n/a

Committee Keywords: WGPE

- ⊕ [Board of Directors](#) [Status]
- ⊕ [Science Council](#) [Status]
- ⊕ [Therapy Physics](#) [Status]
 - ⊕ [Quality Assurance and Outcome Improvement SC](#) [Status]
 - ⊕ [Work Group on Prevention of Errors in Radiation Oncology](#) [Status]
 - [TG100 Method for Evaluating QA Needs in Radiation Therapy](#) [Status]
 - [TG275 Strategies for Effective Physics Plan and Chart Review in Radiation](#)

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THE TEAM – TG275 MEMBERS

- **Eric Ford**, Chair
 - University of Washington
- **Lei Dong**
 - Scripps Proton Therapy Center
- **Luis Fong de los Santos**
 - Mayo Clinic
- **Anne Greener**
 - East Orange VA
- **Jennifer Johnson**
 - UT MD Anderson Cancer Center
- **Perry Johnson**
 - University of Miami
- **Grace Gwe-Ya Kim**
 - University of California, San Diego, Ca
- **James Mechalakos**
 - Memorial Sloan-Kettering Cancer Center
- **Brian Napolitano**
 - AAMD Representative, MGH
- **Stephanie Parker**
 - Novant Health, Winston-Salem, NC
- **Deborah Schofield**
 - Saint Vincent Hospital
- **Koren Smith**,
 - Mary Bird Perkins Cancer Center
- **Michelle Wells**
 - Piedmont Hospital, Atlanta, Ga
- **Ellen Yorke**
 - Memorial Sloan-Kettering Cancer Center

THE TEAM – TG275 MEMBERS

- 14 Members
- Cross-Section of Radiation Oncology Medical Physics
 - Academic and Non-academic Members
 - Geographically Diverse
 - Diverse Work Experience
- Risk Based Assessment Experience
 - TG-100 Member & Other Very Experienced Members
 - FMEA Newbies

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CHARGE OF TG-275

- To review existing data and recommendations
- Survey information on current practices
- Provide risk-based recommendations
- Provide recommendations to software vendors

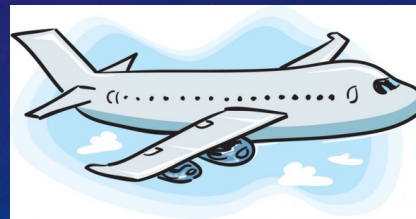
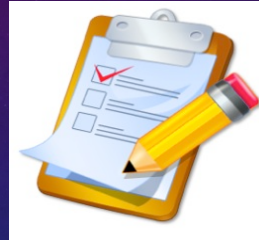
SCOPE OF TG-275

- Types of Procedures
 - External Beam
 - Photon and Electron
 - Brachytherapy
 - Proton
- Types of Checks
 - Initial Plan/ Chart Checks
 - Continuing (Weekly) Physics Checks
 - End of Treatment Checks (EOT's)

OUTLINE

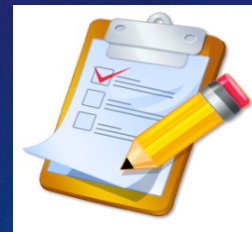
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CREW RESOURCE MANAGEMENT



CREW RESOURCE MANAGEMENT (CRM)

- Introduced in a NASA workshop in 1979
- Set of Training Procedures
- Used in Environments where Human Error can have devastating effects
- Primarily used for Improving Air Safety
- Evolved over time - Several "Generations"
- Has been adapted to other fields



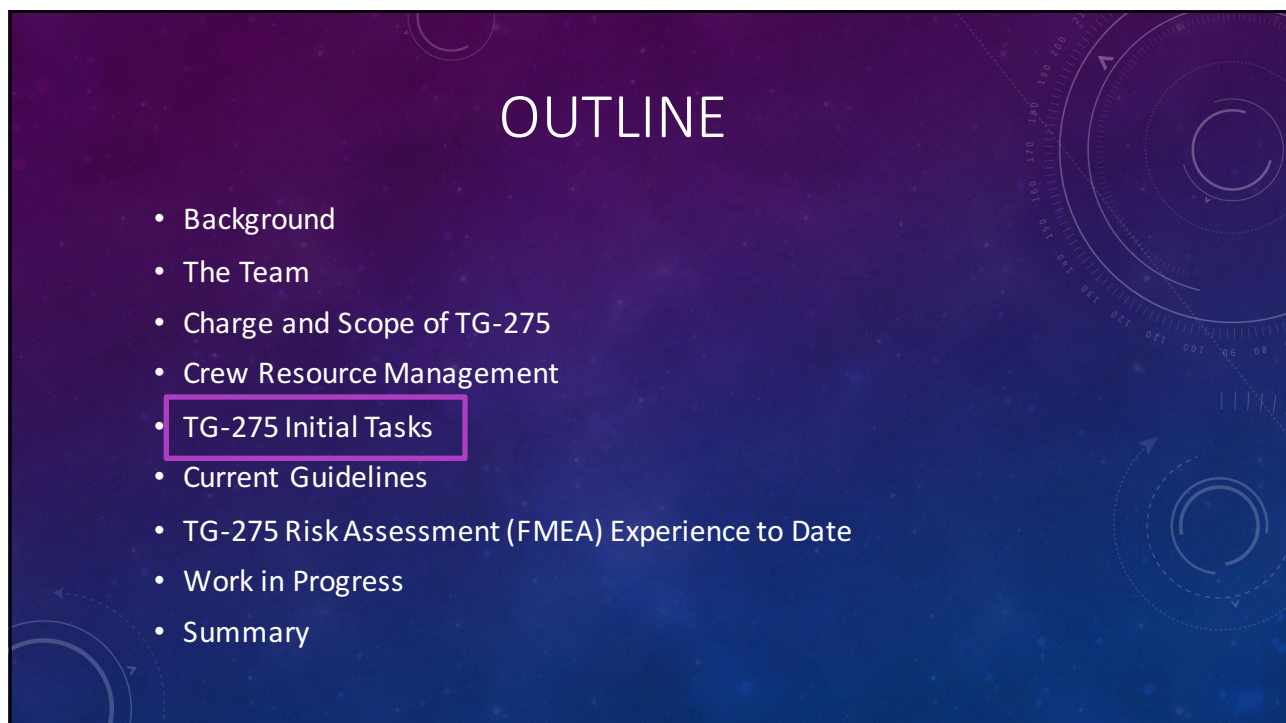
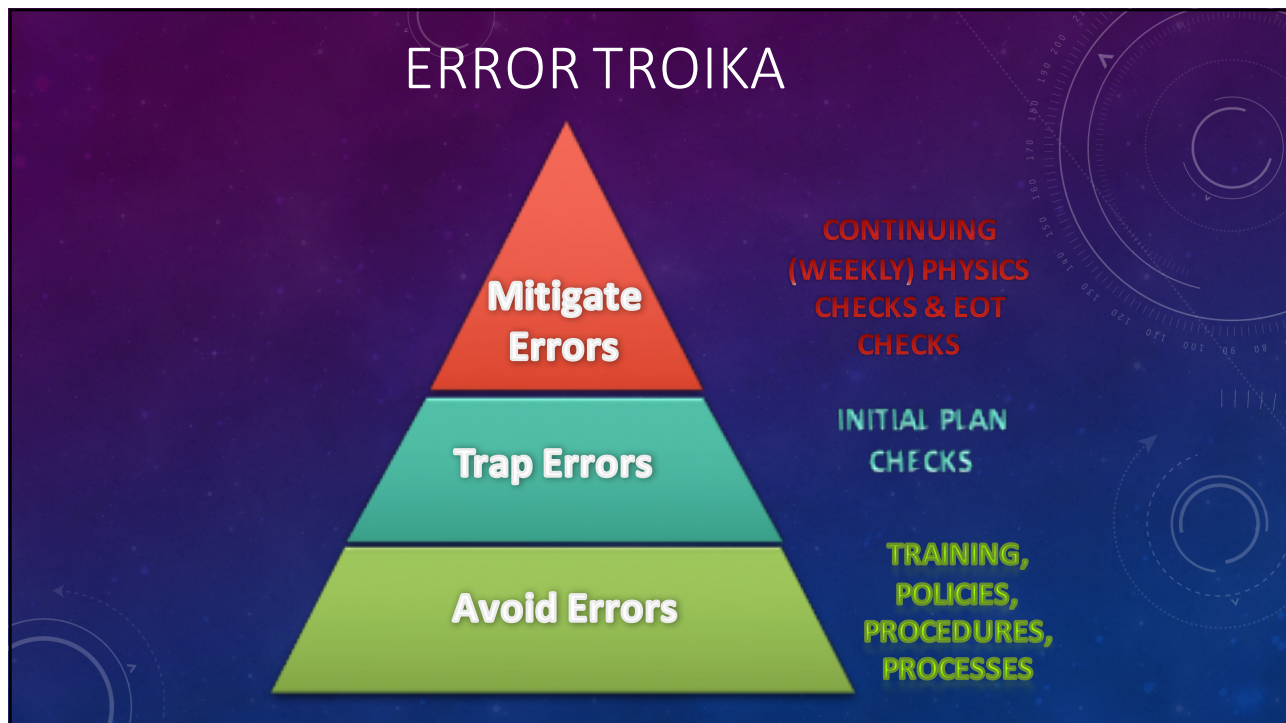
5TH GENERATION CREW RESOURCE MANAGEMENT

- ~ 1990
- Influenced by work of James Reason
- Underlying Premise that Human Error is:
 - Ubiquitous
 - Inevitable
 - Valuable source of information
- Set of Error Countermeasures
 - Three lines of defense
 - “Error Troika”



ERROR TROIKA





TG275 INITIAL TASKS

- Review of Current Recommendations
- Survey of Current Practices
- Risk Assessment Study for External Beam RT

TG Members Divided into Three Groups
to Focus on Specific Tasks

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CURRENT RECOMMENDATIONS & GUIDELINES

3 GUIDELINES

- 3.1 Comprehensive QA for radiation oncology: report of AAPM Radiation Therapy Committee Task Group 40 (#2)
- 3.2 ACR–ASTRO Practice Parameter for Radiation Oncology (#3)
- 3.3 Report of the AAPM Professional Information & Clinical Relations Committee Task Group #11, The solo practice of medical physics in radiation oncology, AAPM Report No. 80 (#19)
- 3.4 High dose-rate brachytherapy treatment delivery: Report of the AAPM Radiation Therapy Committee Task Group No. 59 (#20)
- 3.5 ACR Technical standard for the performance of radiation oncology physics for external beam therapy (#21)
- 3.6 A rapid communication from the AAPM Task Group 201: Recommendations for the QA of external beam radiotherapy data transfer (#29)

PRIMARY GUIDELINE— TG-40 - 1994

VI.	QA OF CLINICAL ASPECTS.....	607
A.	New Patient Planning Conference	607
B.	Chart Review.....	608
1.	Basic Components of a Chart	608
2.	Overview of Chart Checking.....	608
C.	Chart Check Protocol	609
1.	Review of New or Modified Treatment Field	609
a.	Treatment Prescription.....	609
b.	Simulator Instructions	609
c.	Isodose Distributions	609
d.	MU (minutes) Calculation.....	610
e.	In-vivo Measurements	610
f.	Daily Treatment Record.....	610
2.	Weekly Chart Review	610
a.	Review of Previous Fields.....	610
b.	Cumulative Dose	610
3.	Review at Completion of Treatment....	611

TG-275 will apply TG-100 Methodology to Provide an Update to TG-40 Part VI Sections B & C

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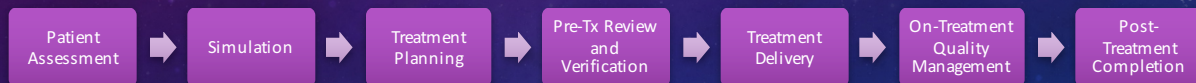
WORKFLOW FOR TG275 RISK ASSESSMENT STUDY

1. Create Process Map
2. Develop Online FMEA Tool on AAPM Website
3. Create Database of Failure Modes
4. Enter Failure Modes and Causes into Online Tool
5. Score FM's using Abbreviated Scale
6. Analyze Results of 3 Point Scale FMEA

WORKFLOW FOR TG275 RISK ASSESSMENT STUDY

7. Remove Low Scoring FM's & Combine Causes for Remaining FM's
8. Score FM's using Standard 10 Point Scale
9. Identify FM's with Score above Threshold
10. Determine which High Scoring FM's Could be Prevented or Mitigated with Plan Checks
11. Develop Recommendations based on FMEA Results

1. HIGH LEVEL PROCESS MAP



2. DEVELOP ONLINE FMEA TOOL ON AAPM WEBSITE

- Eric Ford's Vision
 - Prototype Created using Microsoft Access
 - Worked with AAPM IT Staff to Create Web Version
- Demo'd for FMEA group at 2015 AAPM Meeting

3. CREATE DATABASE OF FAILURE MODES

- Experience of TG-275 Members
 - Individual Lists Generated by Each TG Member
 - Excel Workbook with Worksheet for Each Process Step
- SAFRON
 - 51 Event Identified
 - Potential to be detected on physics review
 - List compared to Current Lists
 - 38 FM/Cause Combinations Added to Database



3. CREATE DATABASE OF FAILURE MODES

- All Lists Compiled into One Workbook
 - Duplicate entries removed
- TG Members Divided into Small Groups
 - Each Group Reviewed List for One Process Step
 - Added Additional FM's
 - Removed All FM's that Would Occur After Initial Plan/Chart Check

3. CREATE DATABASE OF FAILURE MODES


- Validation of Database Against RO-ILS
 - 113 Events Related to Physics Checks Identified by Eric Ford
 - List Compared to Database Generated by Task Group
 - Excellent agreement
 - 97 of 113 events already included in database
 - 10 of the events resulted in new causes
 - 6 events resulted in new failure modes
 - 4 of 6 of minor importance and excluded



3. CREATE DATABASE OF FAILURE MODES

- Final Database
 - 192 Failure Modes
 - Causes for each FM ranged from 1 to 21
 - Total of 594 FM/Cause Combinations

4. ENTER FAILURE MODES AND CAUSES INTO ONLINE TOOL



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Main

TG275 Committee Tree

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TG 275 FMEA TOOL

ID	Project	Committee		
6	TG275: EBRT FMEA -10 Point Scale	TG275	Scores	Failure Mode
4	TG275: EBRT FMEA 3 Point Scale	TG275	Scores	Failure Mode

4. ENTER FAILURE MODES AND CAUSES INTO ONLINE TOOL

TG 275 FMEA TOOL

[Back to Project list](#)

TG275: EBRT FMEA 3 Point Scale

Failure Mode

Process Step Patient Assessment

Cause

Comment
(optional)

[Save](#) [Close](#)

5. INITIAL SCORING USING ABBREVIATED SCALE

Severity

Severity	Description		
1	no harm or mild inconvenience	delete	Edit
2	medium severity	delete	Edit
3	very severe (hospitalization, death, high chance of recurrence)	delete	Edit

[Enter new Severity](#) | [Add from template](#)

Occurrence

Occurrence	Event Rate	Events Per Year		
1	very rare. almost never seen.	.	delete	Edit
2	sometimes occurs	.	delete	Edit
3	frequent	.	delete	Edit

[Enter new Occurrence](#) | [Add from template](#)

Detectability

Detect Number	Probability Undetected		
1	very rare. almost never seen.	delete	Edit
2	sometimes occurs	delete	Edit
3	frequent	delete	Edit

[Enter new Detectability](#) | [Add from template](#)

5. INITIAL SCORING USING ABBREVIATED SCALE

- Scoring Instructions
 - Enter scores based on experience at your institution
 - **Detectability score:**
 - Score this with the view of what is detectable PRIOR to the initial physics plan and chart review.
 - **Severity score.**
 - Score as if the failure goes all the way through to the patient.
 - Score for the most reasonably likely scenario
 - i.e. not the worst-case scenario
 - can almost always image a scenario where a failure mode propagates in a certain way as to become a severity of 10

5. INITIAL SCORING USING ABBREVIATED SCALE

- Individuals Entered Scores on the AAPM Website
- Scoring Open from April 15 to May 9 2016
- Time Consuming Even With 3 Point Scale
 - ~ 3.5 hours

5. INITIAL SCORING USING ABBREVIATED SCALE

FM Order	95
Failure Mode	CT dataset Loaded from a different patient 🗑 Delete score 💾 Save
Cause	incorrect scan sent from sim (scan completed with incorrect patient name and information)
Process Step	Treatment Planning
Comment	[+ Add]
Severity	3 very severe (hospitalization, death, high chance of recurrence) ▾
Occurrence	Rate for 500 pts/year 1 very rare. almost never seen. ▾
Detectability	Probability of detecting 2 sometimes occurs ▾

6. ANALYSIS OF 3 POINT SCALE FMEA

- RPN Scores: 1 to 13.94
- Severity Scores: 1 to 3

5. INITIAL SCORING USING ABBREVIATED SCALE

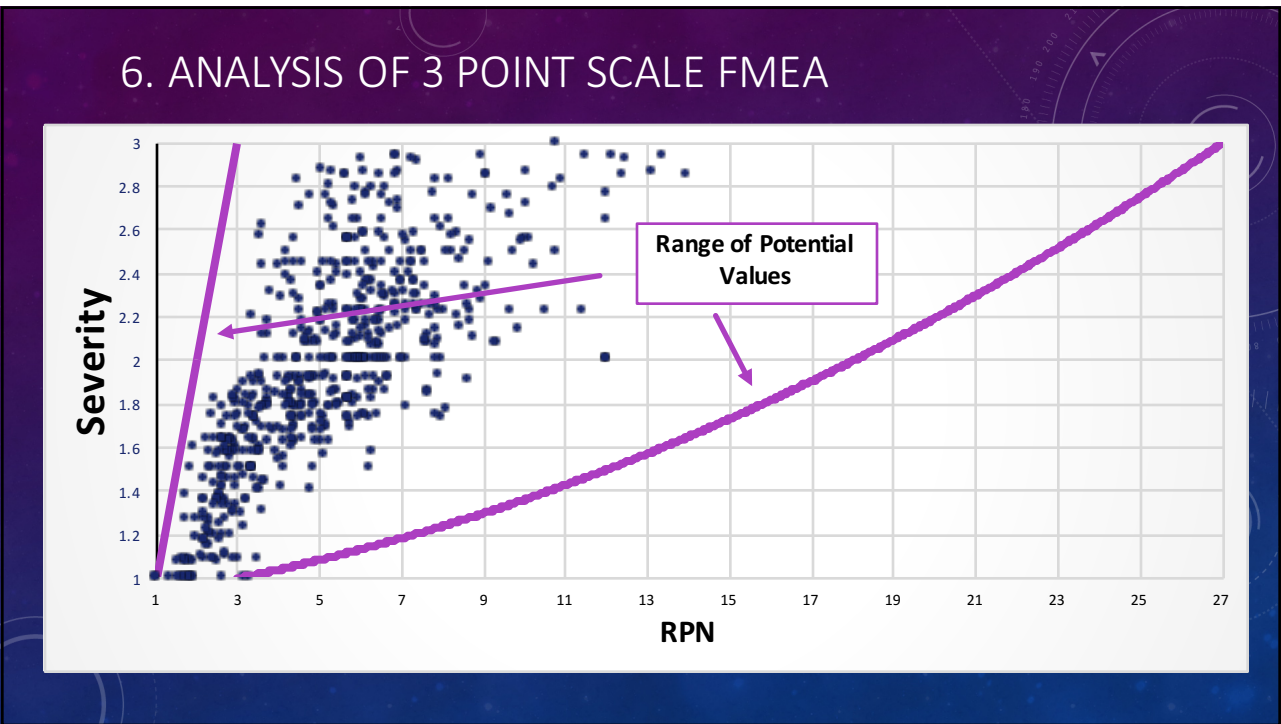
FM Order	144			
Failure Mode	Incorrect isocenter in cone-beam CT reference data			
Cause	CBCT isocenter coordinates changed in IGRT system (e.g. +/- polarity typo in Mosaic)			
Process Step	Treatment Planning			
Comment	[+ Add]			
Individual Score				
IndID	Name	Severity	Occurrence	Detectability
		3	1	1
		2	1	1
		3	2	2
		3	3	2
		3	1	3
		3	1	1
		2	2	1
		3	1	3
		2	1	1
		2	1	2
Consensus Final Score				
Severity	2.6			
Occurrence	Rate for 500 pts/year 1.4			
Detectability	Probability of detecting 1.7			

High Variability in
Detectability

5. INITIAL SCORING USING ABBREVIATED SCALE

FM Order	104			
Failure Mode	Unintentional re-irradiation of a previously treated area			
Cause	MD aware of prior rads but did not communicate			
Process Step	Treatment Planning			
Comment	[+ Add]			
Individual Score				
IndID	Name	Severity	Occurrence	Detectability
		3	1	3
		3	1	2
		3	1	2
		3	2	2
		3	1	3
		3	2	2
		3	1	3
		3	1	3
		3	2	3
		3	1	3
		3	3	3
		3	1	3
		3	1	2
		3	1	3
Consensus Final Score				
Severity	3			
Occurrence	Rate for 500 pts/year 1.36			
Detectability	Probability of detecting 2.64			

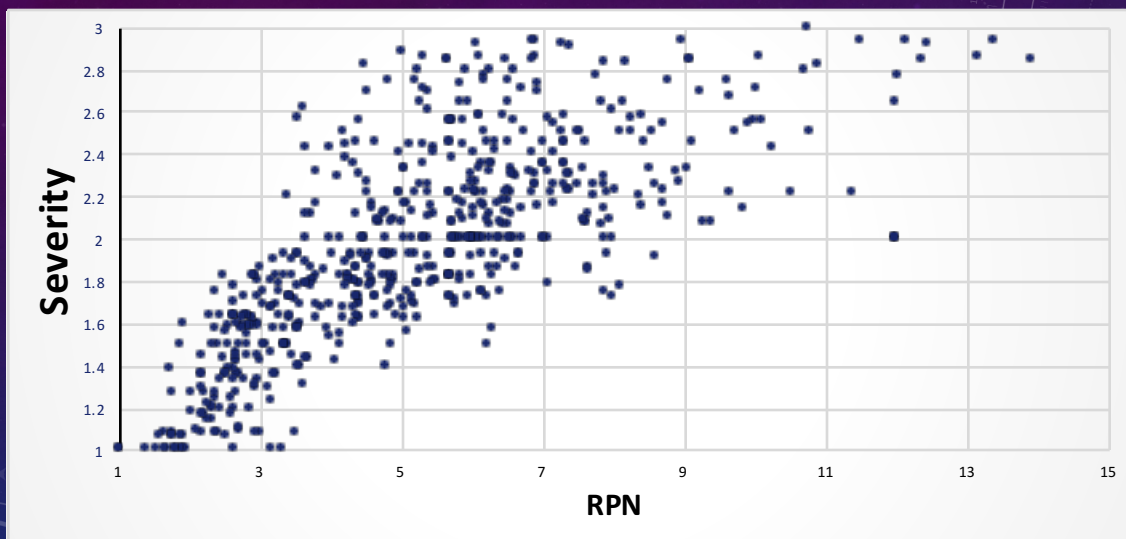
Highest Ranking
Severity
S = 3



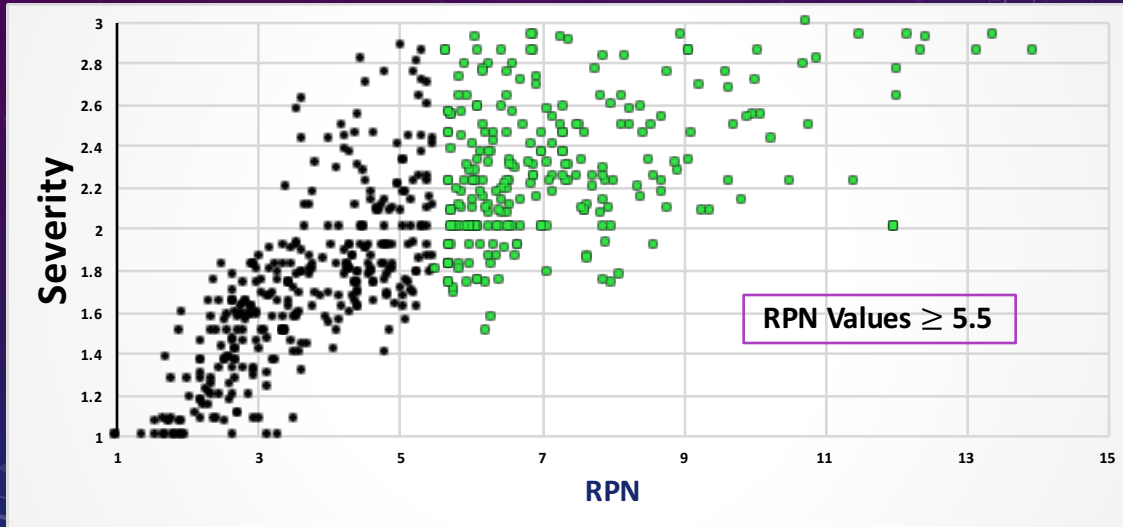
7. REMOVE LOW SCORING FM'S

- Needed to Determine Threshold for Elimination of Low Scores
- Decided to Keep top 40% of both RPN and S Scores
- Kept FM's with $RPN \geq 5.5$ and $S \geq 2$

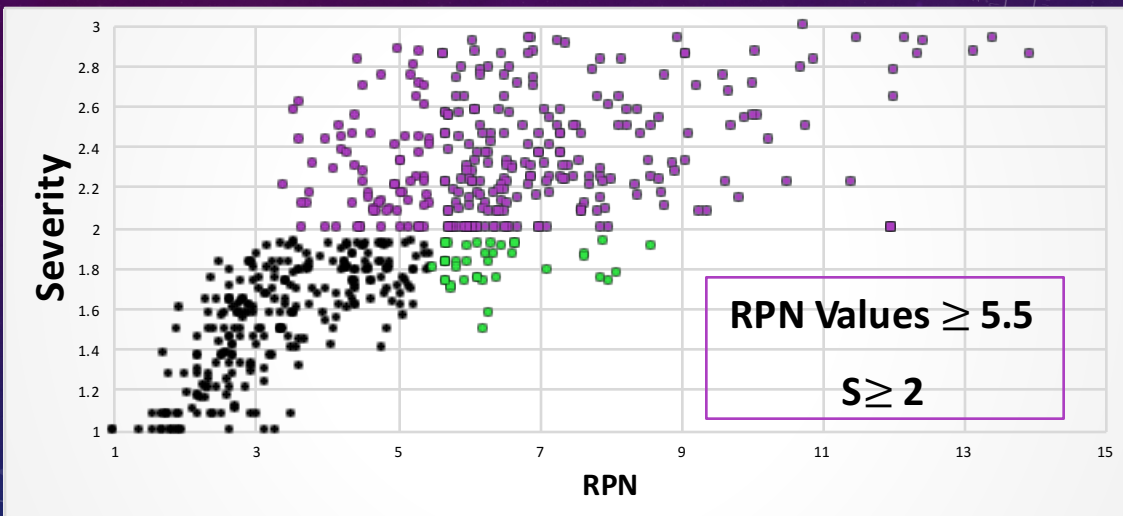
7. REMOVE LOW SCORING FM'S



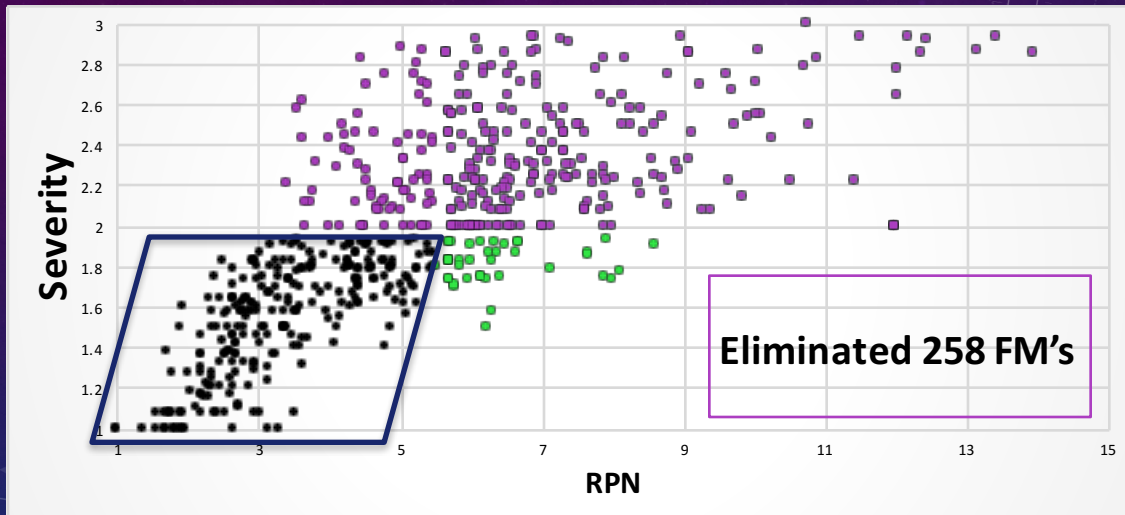
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7. REMOVE LOW SCORING FM'S

- Started with 594 Failure Mode/ Cause Combinations
- Eliminated 258 that Fell Below the Threshold
- 336 Remaining - Still too many
- Combined Causes for Many FM's
- Final Result for 10 Point Scale Scoring – 118 FM/Cause Combinations

8. SCORE FM'S USING STANDARD 10 POINT SCALE

- Scoring Open June 27- July 11, 2016
- 1 to 1.5 Hours to Complete Scoring

IN PROGRESS

7. Identify FM's with Score above Threshold
8. Determine which High Scoring FM's Could be Prevented or Mitigated with Plan Checks
9. Develop Recommendations based on FMEA Results

ALSO IN PROGRESS

- Weekly and EOT Chart Check FMEA
- Brachytherapy FMEA
- Proton Therapy FMEA

SUMMARY

- TG-275 has completed most of the External Beam Initial Physics Plan/Chart Check FMEA
- Currently analyzing data from the 10 Point Scale Scoring
- Unique features of TG-275 FMEA
 - Multi-institutional experience considered
 - Used an Online FMEA Tool
 - Initially Used 3 Point Scale Scoring
 - Scored based on most likely scenario instead of worst case scenario

THE END

- Thank you for your time and attention!

REFERENCES

- ACR–AAPM TECHNICAL STANDARD FOR THE PERFORMANCE OF RADIATION ONCOLOGY PHYSICS FOR EXTERNAL BEAM THERAPY
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