JULY 12–16 2020 VIRTUAL JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

Failure Mode and Effects Analysis for PET applications in Radiation Therapy Quality Management

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INTRODUCTION

TG-100 [1] suggests that Quality Management (QM) programs utilize a **risk-assessment based approach utilizing Failure Mode and Effects Analysis (FMEA)** rather than a prescriptive approach.

Recently published AAPM Report from TG-174 [2] provides prescriptive recommendations for periodic QA for PET/CT simulators.

We have recently evaluated **our nine years of PET/CT RT QM experience** against the TG-174 recommended tests and tolerances, results of which are presented at this conference [3]. These results showed **very good consistency with the TG-174** recommended tests and rarely failed the tests.

We concluded that our QM could potentially be optimized.

PURPOSE

We investigated a framework for FMEA for PET/CT RT QM in the context of **PET applications in target contouring**.

METHODS

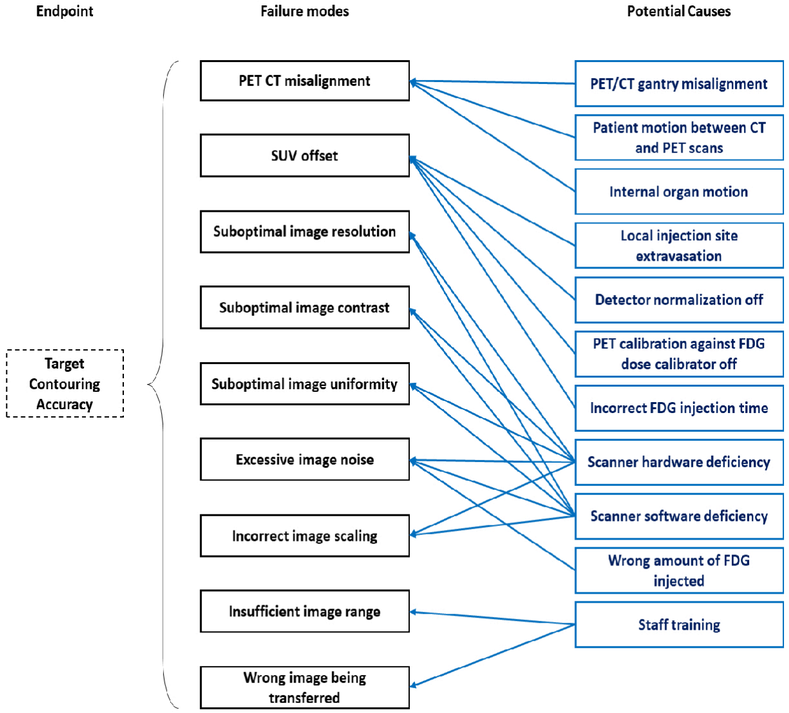
Possible failure modes were identified by two medical physicists with input from a radiation oncologist.

The **severity (S)** of a failure mode was assessed by its impact on contouring accuracy. **The occurrence (O)** and **detectability (D)** were derived from analysis of daily and monthly QA, retrospective review of clinical PET/CT images, physicists' experience, expectation of staff performance, and possible causes of each failure mode.

The **Risk Priority Number (RPN)** was calculated from O, S, and D using a 1 - 10 scale utilizing relative importance ranking.

The **first stage FMEA** assumed no QM. A **second stage FMEA** re-evaluated the scores with our current quality control (QC)/QA, and the remaining high RPN failure modes were identified.

RESULTS



	Stage 1 FMEA - no QA/QC/QM				Stage 2 FMEA - current QA/QC/QM			
Failure Mode	**O**	**S**	**D**	**RPN**	**O**	**S**	**D**	**RPN**
PET CT misalignment	7	9	4	**252**	6	9	3	**162**
SUV offset	5	6	9	**270**	3	6	5	**90**
Suboptimal image resolution	2	7	5	**70**	2	7	2	**28**
Suboptimal image contrast	2	7	5	**70**	2	7	2	**28**
Suboptimal image uniformity	2	4	7	**56**	2	4	2	**16**
Excessive image noise	4	5	7	**140**	4	5	4	**80**
Incorrect image scaling	1	8	3	**24**	1	8	2	**16**
Insufficient image range	2	8	1	**16**	2	8	1	**16**
Wrong image transferred	1	10	1	**10**	1	10	1	**10**

CONCLUSIONS

FMEA was able to quantitatively assess the current impact of our PET/CT RT QM.

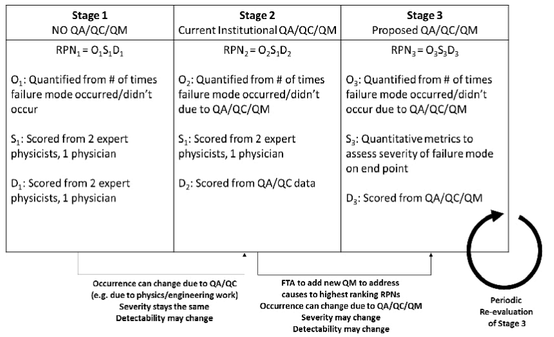
Failure Modes with largest reduction from 1st to 2nd stage:

- **SUV Offset**
- **PET/CT misalignment**

Failure Modes with no reduction from 1st to 2nd stage:

- **Wrong image transferred**
- **Insufficient image range**

Future work includes implementation of a potential third stage with **periodic re-evaluation FMEA.**



REFERENCES

[1] Huq, M. Saiful, Benedick A. Fraass, Peter B. Dunscombe, John P. Gibbons Jr, Geoffrey S. Ibbott, Arno J. Mundt, Sasa Mutic et al. "The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management." Medical physics 43, no. 7 (2016): 4209-4262.

[2] Das, S. K., McGurk, R., Miften, M., Mutic, S., Bowsher, J., Bayouth, J., ... & Xing, L. (2019). Task Group 174 Report: Utilization of [18F] Fluorodeoxyglucose Positron Emission Tomography ([18F] FDG-PET) in Radiation Therapy. Medical physics, 46(10), e706-e725.

[3] PO-GeP-T-708

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