Error Reduction Model in Radiation Therapy

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Purpose/Objective

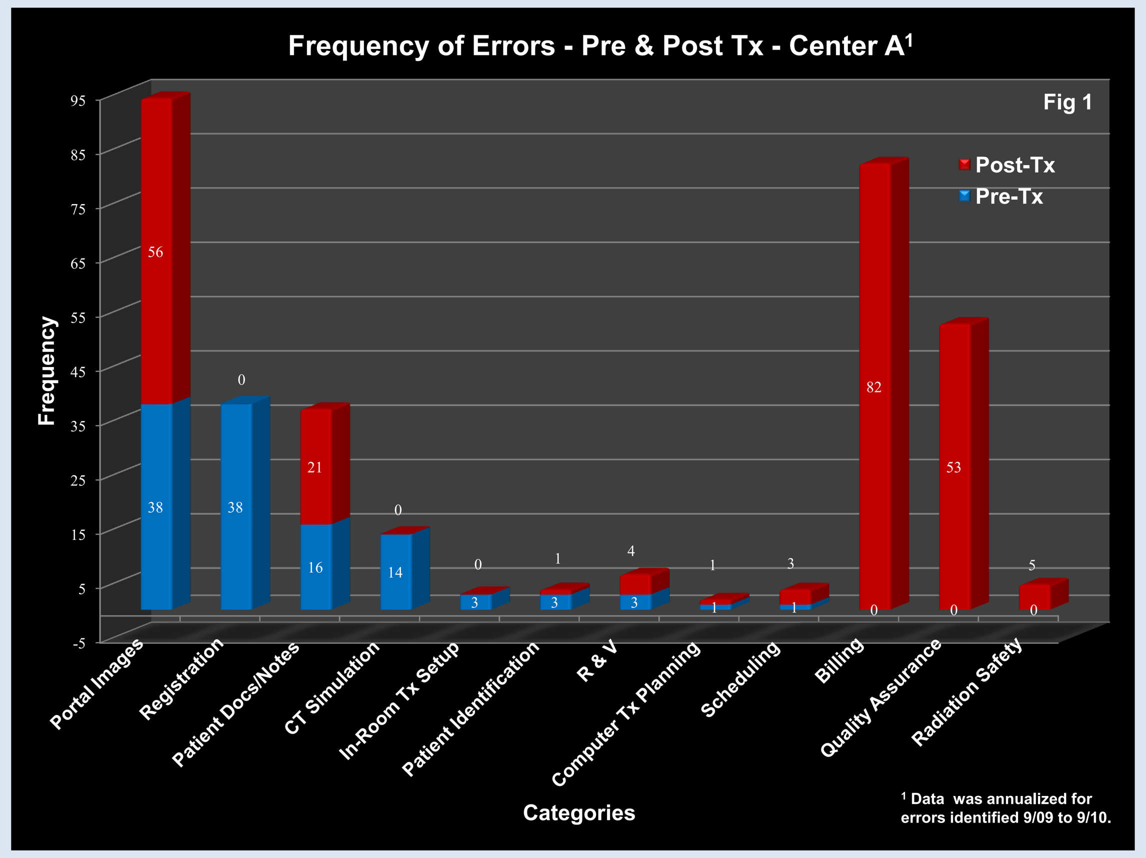
Medical errors in radiation oncology are receiving increased public and government scrutiny. This work examines the results of implementing a software-based program to reduce the overall number of incidents, adverse events, and regulatory infractions. Audits validated the effectiveness of the program.

Materials/Methods

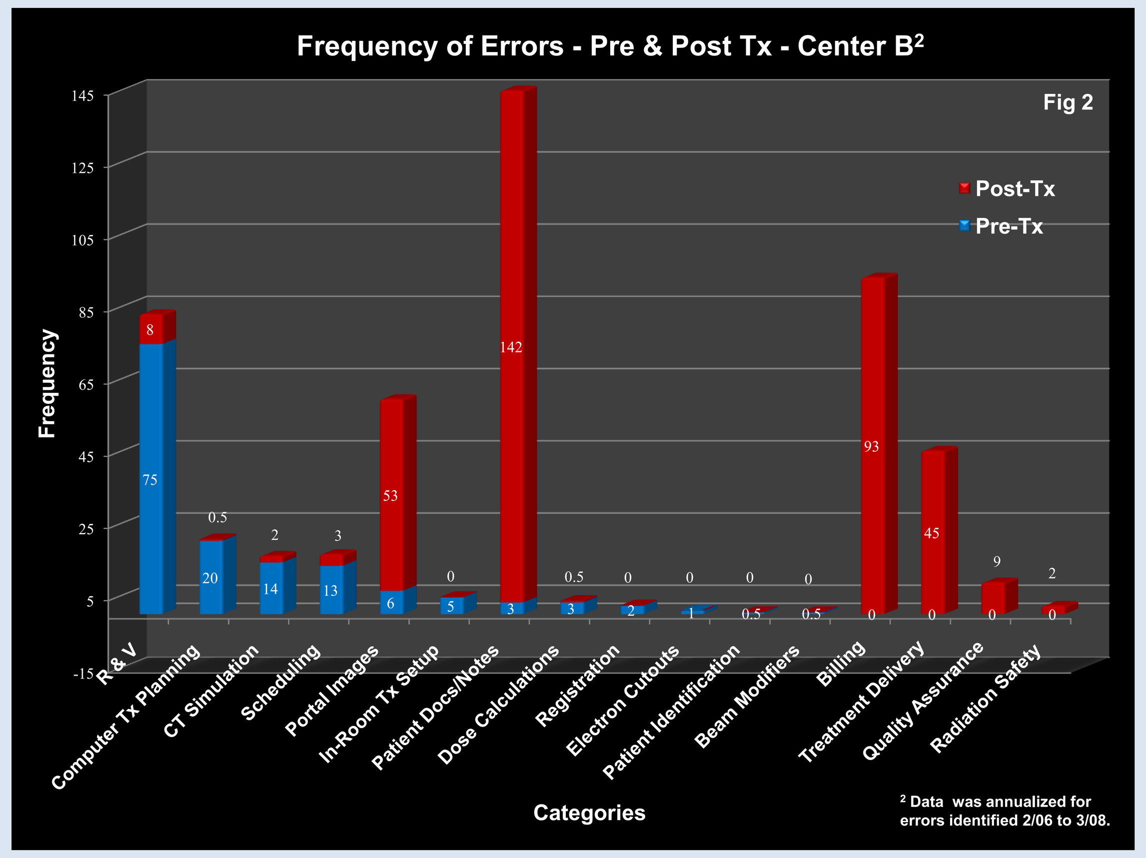
- Software program was implemented at radiation oncology centers A and B over 2 years and 1 year, respectively.
- Used to self-identify, categorize, evaluate, and correct pre and post-treatment errors and infractions found in the overall treatment process.
- Errors are classified based on type, category, attribute, and significance. Reports follow root-cause analysis. Errors are automatically routed to designated reviewers. Links allow creation of benchmark procedures.

Results

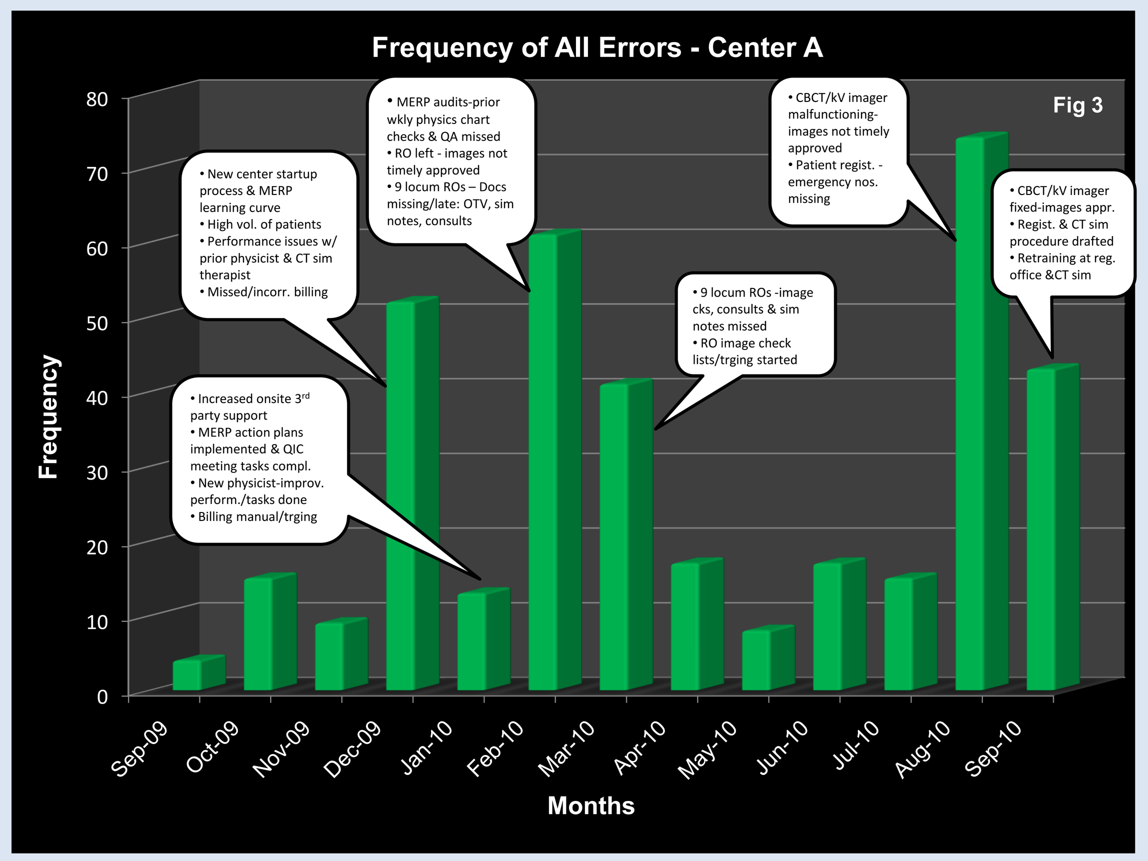
A total of 1,460 (438 pre-Tx and 1,022 post-Tx) errors were identified at both centers. Centers A and B experienced 0 vs. 2 medical events and 2 vs. 4 near misses, respectively. Center B had 7 clinically significant errors, defined as a single fraction dose difference of > than 10% and weekly dose > than15%.



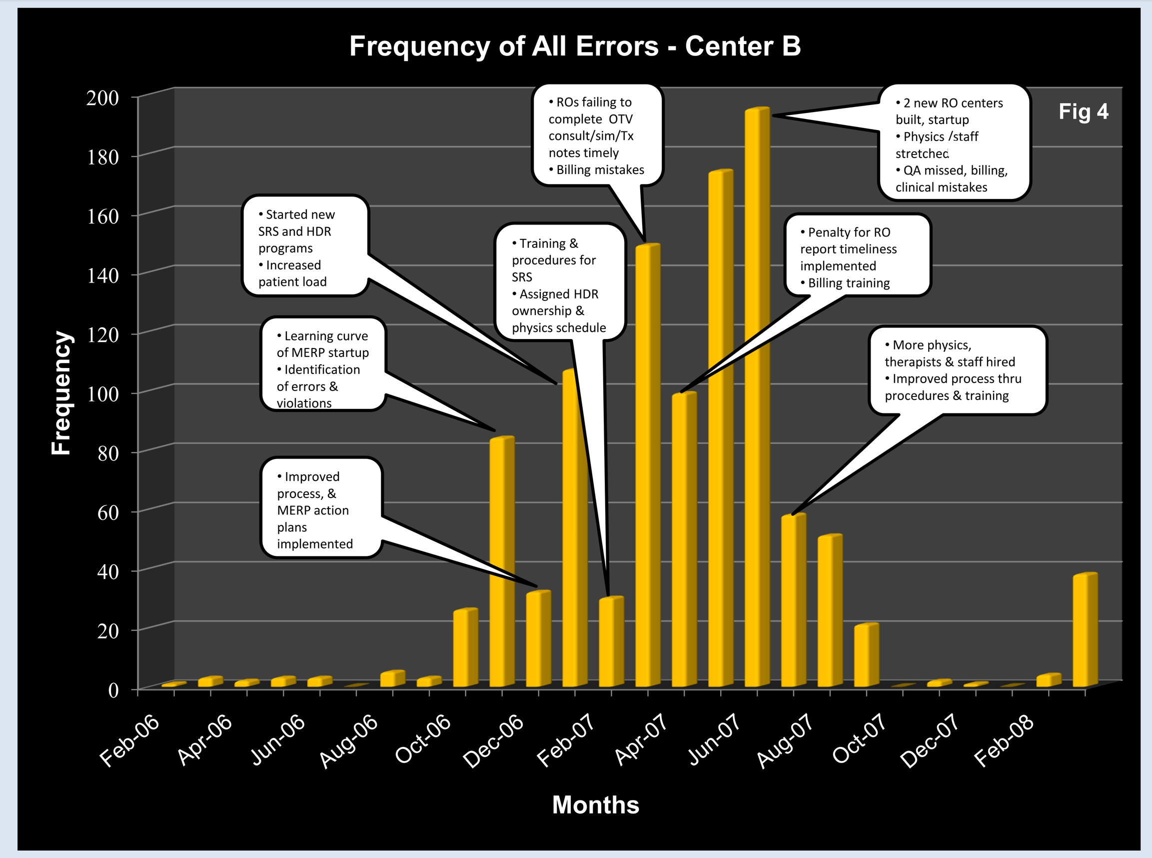
Portal imaging, billing, & QA were problem areas at Center A (Fig 1).



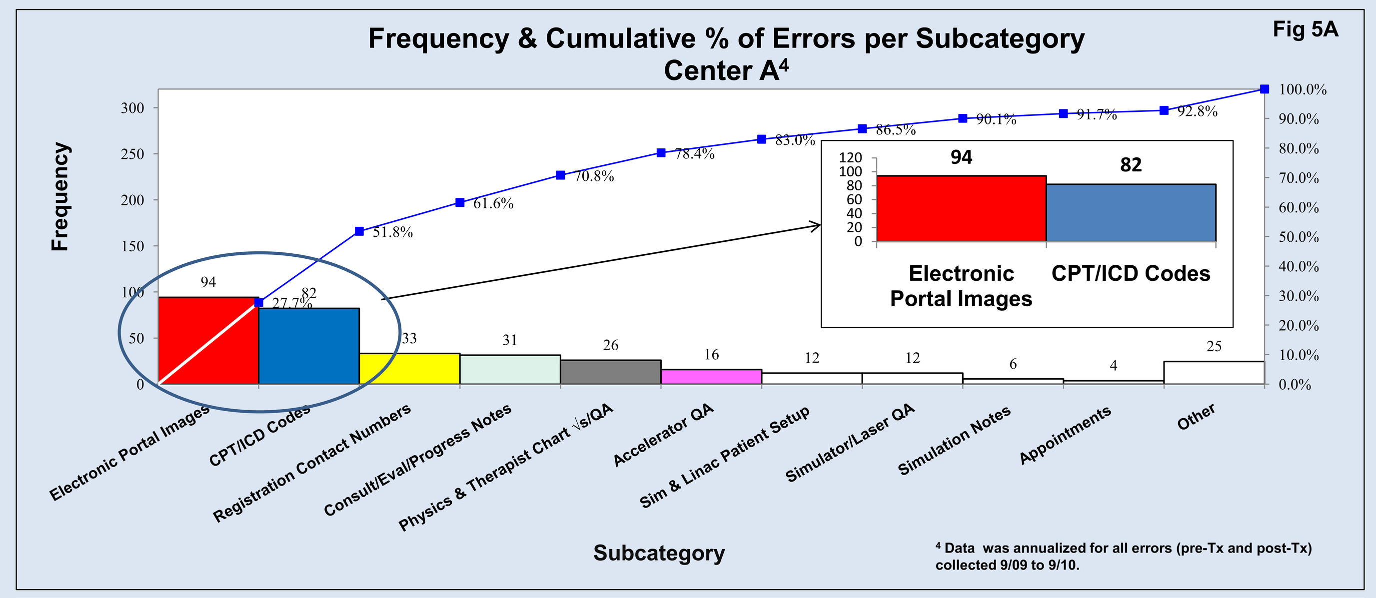
Patient consults/notes, R&V data entry, & billing errors occurred most at Center B (Fig 2).

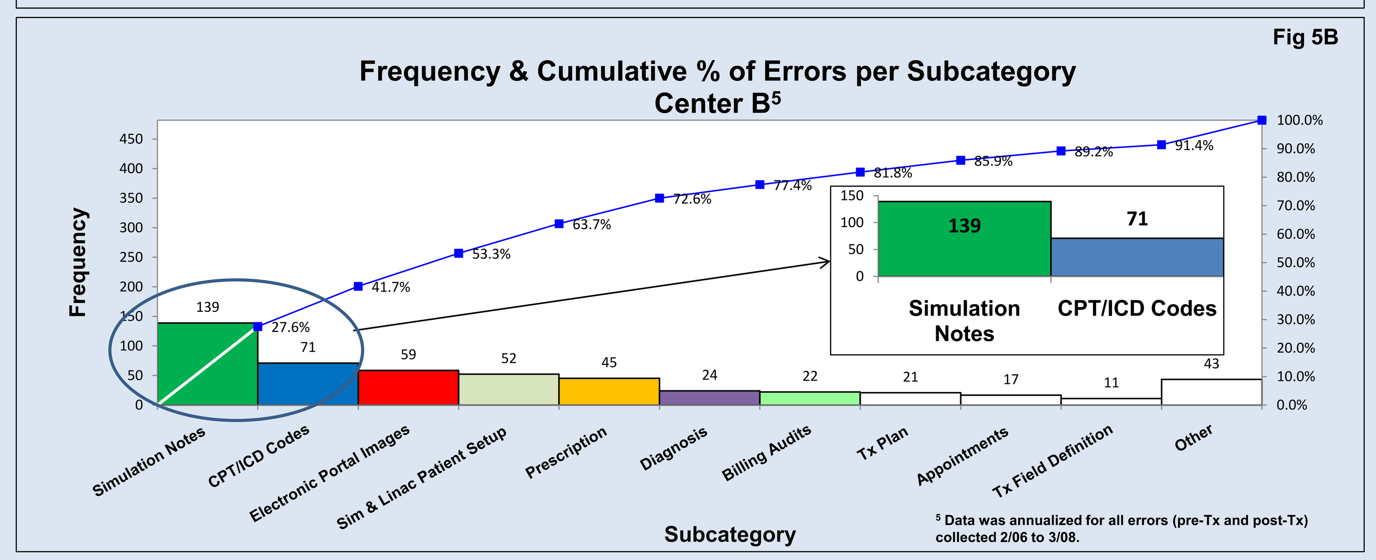


Action plans were effective in reducing errors in process & performance at Center A (Fig 3).

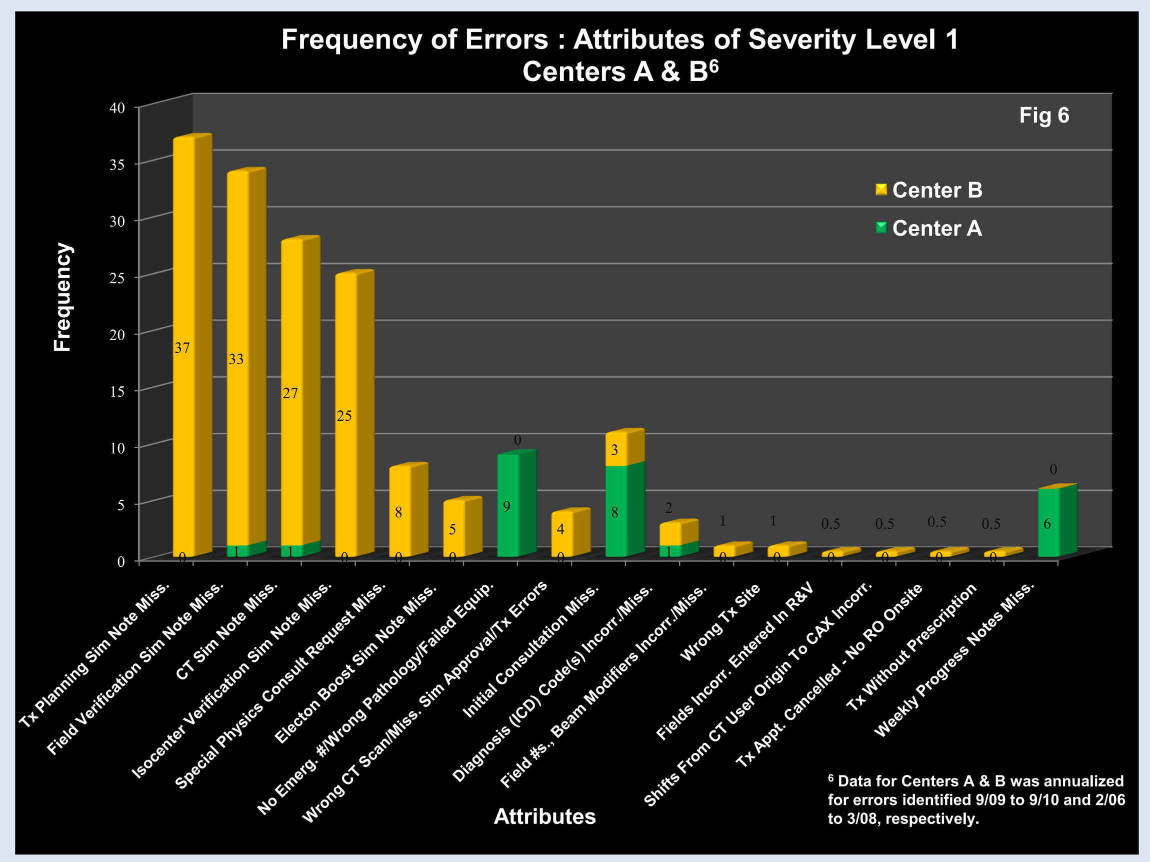


Root cause analysis worked at Ctr. B (Fig 4).





Both centers had high nos. of billing errors (Fig 5A/5B).



Ctr. B produced more significant errors (Fig 6).

Table 1: Error Rates in Treatment Delivery[7,8]

Error Category	This Work Software Center A	This Work Software Center B	Kline et al.	Frass et al.	French	Huang et al.	Marks et al.	Macklis et al.	Patton et al.	Margalit et al.
Per Patient, %	0.32	3.20				1.97	1.2 - 4.7			
Per Fraction, %	0.01	0.11		0.44	0.32	0.29	0.5			
Per Field, %	0.001	0.001		0.13	0.037			0.18	0.17	0.064
Overall Per Field, %	0.28 [a]	0.009 [a]	0.05 [a]		0.13 [b]					

[7] Treatment delivery means the administration of radiation.
[8] Data for Centers A and B was annualized for all Tx errors identified from 9/09 to 9/10 and 2/06 to 3/08, respectively.
[a] Errors per field in the entire post-Tx delivery process (from initial patient consultation to completion of Tx).
[b] Errors per total Tx units.

Center B experienced 45 errors in treatment delivery vs Center A only 1 (CBCT)(Table 1).

Table 2: Error Rates in Entire Treatment Process[8]

Error Category	Pre-Tx		Post-Tx		Pre-Tx + Post Tx	
	Center A 115 errors	Center B 145 errors	Center A 225 errors	Center B 362 errors	Center A 340 errors	Center B 477 errors
Per Patient, %	37.20	10.10	72.80	25.40	81.80	27.33
Per Fraction, %	1.10	0.34	2.10	0.85	2.40	0.92
Per Field, %	0.14	0.004	0.28	0.01	0.31	0.01

[8] Data for Centers A and B was annualized for all pre-Tx and post-Tx errors (all aspects of the treatment process from registration to completion of treatment) identified from 9/09 to 9/10 and 2/06 to 3/08, respectively.

Higher error rates at Ctr. A due to startup of new center w/ high patient volume (Table 2).

Table 3: Likelihood of Occurrence Infractions of Federal/State Regulations per Patient[9]

Category	Center A 309 patients	Center B 659 patients
CMS Billing, %	26.54 [a]	5.1 [b]
State Required QA, %	2.59	0.19
State Required Radiation Safety, %	1.62	0.23

[9] Data for Centers A and B was annualized for all data collected 9/09 to 9/10 and 2/06 to 3/08, respectively.
[a] Approximately 80% of the infractions were caught/corrected at time of charge capture and before exporting to CMS or insurance company.
[b] Approximately 50% of the infractions were caught/corrected at time of charge capture and before exporting to CMS or insurance company.

Center A startup problems result in charge capture errors & physics turnover (Table 3).

Conclusion

The software program proved to be an effective tool for reducing errors. Process weaknesses resulted in most errors of clinical significance. Action plans showed improvement in problem areas.