

Reducing Accelerator Downtime – Log Monitoring and Active Management

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Purpose: To develop an accelerator monitoring and maintenance program that helps minimize downtime during normal clinic treatment hours for a regional radiotherapy network.

Methods: Program elements include: vendor maintenance contracts and specific engineer-site assignments; accelerator fault and warning tracking by therapist site team; weekly event log and fault-warning log review by site physicist; and monthly technical review by physics leadership. Service contracts for each accelerator includes extended service coverage to 9 pm. Site specific software tools were developed to log and monitor each operational aspect and allows active management of each accelerator. Current monitoring includes eight accelerators at seven sites. The vendor service team attends facility team meetings to discuss clinical use and operational events. The radiation oncology staff is incentivized to log all operational warnings and faults. Compliance is scored on a five-point scale with staff annual reviews and compensation impacted by the compliance score. Monthly review ensures actionable operational issues are resolved proactively. Ongoing analysis of accelerator downtime is documented using field service statistics and facility tracking.

Results: Compliance scores for each clinic range from 95 to 100 percent over the first 8 months of program operation. Overall compliance is 97.3 percent. Overall machine downtime for calendar year 2015 was 4.7 percent. In 2016 only one clinic had an increase in downtime due to a major system failure and facility electrical power issues in January 2016. Machine downtime for calendar year 2016 was 2.6 percent, a significant decrease. Alternatively, downtime was decreased from 676 hours in 2015 to 368.9 hours in 2016. In addition, by gaining 307.1 hours of accelerator operating time, the increase in net profit is approximately 338 thousand dollars to the practice.

Conclusion: A systematic, focused program for decreasing accelerator downtime that includes all radiation oncology stakeholders can increase operational availability of accelerator systems.

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The goal is to increase the availability (up-time) of the linear accelerators. With the RTT staff documenting the machine faults and warnings along with physicist monitoring the log files, we can implement repairs and maintenance prior to equipment failure and during non-clinical hours. The site team reviews and discusses any operational issues, trends and repairs with the director of physics and vendor service manager on a monthly basis. A five point scoring system is used to determine the compliance of RTT staff and physicists by comparing the in-house software tools/documentation to service reports and documented downtime. The warning and error log compliance is part of each RTT and physicists' annual review and is a factor in determining eligibility for merit increases. Compliance scores for each clinic ranges from 95% to 100% over the first 8 months of program operation [table 1]. Overall compliance is 97.3% across all centers.

		Florida Cancer Specialist Accelerator Log File Review Summary Report 2016						Performed by:	Director of Physics
Monthly Facility/Physicist Review	Tasks Reviewed	Site 1: 21 EX	Site 2: Trilogy	Site 3: 21 EX	Site 4: 21 EX	Site 5: Trilogy	Site 6: Trilogy	Site 7: TB	
Preemptive Accelerator Maintenance									
May	Machine Error Log Complete	5	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	5	5	3	5	5	N/A	
June	Machine Error Log Complete	5	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	5	5	5	5	5	N/A	
July	Machine Error Log Complete	5	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	4	5	5	5	5	N/A	
August	Machine Error Log Complete	5	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	5	5	5	5	5	N/A	
September	Machine Error Log Complete	3	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	4	5	3	5	5	N/A	
October	Machine Error Log Complete	5	5	5	5	5	5	5	
	Accelerator Log Files Reviewed	5	5	5	5	5	5	N/A	
November	Machine Error Log Complete	5	5	5	5	5	5	4	
	Accelerator Log Files Reviewed	5	5	5	5	5	5	N/A	
December	Machine Error Log Complete	5	5	5	5	5	5	4	
	Accelerator Log Files Reviewed	4	4	4	5	5	4	N/A	
Comments								Log files reviewed remotely by Varian Medical	
Score: 5-complete; 0-Not done	Total Score	77	77	79	76	80	79	38	
	Completion Percentage	96.25%	96.25%	98.75%	95.00%	100.00%	98.75%	95.00%	

Overall machine uptime for 2016 is 97.4% up from 95.3% in 2015 [table 2]. The number of hours of downtime is determined for each month for each accelerator location. Uptime % is calculated: $[1 - (\text{avg hours per month} / (\text{Bus Day per month} \times 8 \text{ hours/day}))] \times 100$. The actual downtime has been reduced from 676 hours in 2015 to 368.9 hours in 2016.

Florida Cancer Specialist - Linear Accelerator Uptime															
Site	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Average
Site 1: 21 EX	2015	1	2	5	3	4	10	4	0	3	43	21	21	117	9.8
	2016	2	11	2	4.4	0.5	0	6	2.25	1	7	2	0	38.15	3.2
Site 2: Trilogy	2015	5	5	6	0	0	2	5	5	6	5	3	5	47	3.9
	2016	1	2	3	4	4.75	0	9	8	0	1	0	0	32.75	2.7
Site 3: 21 EX	2015	5	2	7	9	120	7	1	19	7	5	5	25	92	8.4
	2016	6	23	2	6.5	0	1	2	5	2	6	0	0	53.5	4.5
Site 4: 21 EX	2015	8	2	1	1	0	1	4	2	23	11	8	1	62	5.2
	2016	14	0	2.5	3.2	0	1	0	11	8	1	12	0	52.7	4.4
Site 5: Trilogy	2015	5	7	10	1	38	2	0	5	3	5	1	3	80	6.7
	2016	2	4	1.25	1	0	0	1	1.5	1	10	5	0	26.75	2.2
Site 6: Trilogy	2015	0	0	0	9	8	18	9	0	8	5	1	0	58	4.8
	2016	0	11	15	1	0	0	0	1.5	0	0.5	0	0	29	2.4
Site 7: TB	2015	6	16	9.5	9	3	0	1	4	10	15.5	6	20	100	8.3
	2016	89	4	2	14	0	7	0	0	6	4	10	0	136	11.3
2015 Total		30	34	38.5	32	173	40	24	35	60	89.5	45	75	676	
2016 Total		114	55	27.75	34.1	5.25	9	18	29.25	18	29.5	29	0	368.85	
2015 Avg		4.29	4.86	5.50	4.57	24.71	5.71	3.43	5.00	8.57	12.79	6.43	10.71		
2016 Avg		16.29	7.86	3.96	4.87	0.75	1.29	2.57	4.18	2.57	4.21	4.14	0.00		
2015 Uptime %		97.45%	96.96%	96.88%	97.40%	85.29%	96.75%	98.14%	97.02%	94.90%	92.74%	95.98%	93.91%	95.30%	95.29%
2016 Uptime %		89.82%	95.09%	97.85%	97.10%	99.55%	99.27%	98.39%	97.73%	98.47%	97.49%	97.53%	100.00%		97.36%
2015 Bus. Days		21	20	22	22	21	22	23	21	21	22	20	22	257	
2016 Bus. Days		20	20	23	21	21	22	20	23	21	21	21	22	255	