Troubleshooting issues with linear accelerators
Steven Sutlief, PhD DABR FAAPM
UC San Diego

Disclosures
• I have nothing to disclose.

Objectives
• Understand why unscheduled linac downtime should be minimized
• Understand the competencies of linac troubleshooting
• Understand common approaches for using fault event reporting to minimize downtime
Outline

- The downside of downtime and the first step to minimizing it
- How several institutions minimize downtime
- Take home points

**The Downside of Downtime and the First Step to Minimizing It**

<table>
<thead>
<tr>
<th></th>
<th>Daily</th>
<th>Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and Neck</td>
<td>1.4%</td>
<td>10% – 12%</td>
</tr>
<tr>
<td>Lung</td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>Cervix</td>
<td>0.3% – 1.6%</td>
<td></td>
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</tbody>
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Loss of local control based on duration of treatment interruption.

Guidance on timely radiation therapy delivery (2)

Risk stratification of patients:

- **Category 1:** Rapidly growing tumors (e.g., squamous carcinomas) – don’t exceed 2 days
- **Category 2:** Slower growing tumors (e.g., adenocarcinomas) – don’t exceed 2 days*
- **Category 3:** Palliative treatment – 7 days

Guidance on timely radiation therapy delivery (3)

- Ideal: transfer to a matched linear accelerator
- Be able to perhaps
  - treat over the weekend
  - twice daily
  - add extra treatment fractions
- Use biologically equivalent dose calculations to determine a modified number of treatment fractions

Step 1: Read the Manual

Example:

- TrueBeam Administrators Guide, Chapter 7: Troubleshooting
- TrueBeam / Instructions for Use, Appendix J: Acknowledging Fault Interlock Messages
How Several Institutions Minimize Downtime

Capturing machine issues in a text document (Seattle VA)

Table of Contents
- Contacting Delta ........................................... 2
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- How to Replace the OHS Light .................... 6
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UCSD Radiation Oncology
Quality Reporting System-Machine Log
Old Way  New Way

Telephone calls through multiple points of contact and repeated verbal descriptions of the problem before receiving technical assistance from a local service engineer.

Electronic description of the problem, including fault codes, is delivered immediately to local staff and the field service dispatch person.

Greater reliance on field service engineers to resolve problems.

Clinical users learned how to resolve technical events with remote assistance; issues could be resolved in minutes.

Greater uncertainty about the potential length of downtime resulted in more cancellations of patient appointments.

More accurate estimate of the duration of a machine-down event and its impact upon the patient treatment schedule.

Hoisak et al, JACMP 15:257-264, 2014
UCSD ROQRS-ML Experience

- Fix
- Unexplained
- Partially Documented
- Temporary Fix
- Unknown

Sutlief, SU-F-T-462 (2016) (poster)

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UCSD ROQRS-ML Experience

- Therapist
- Physics
- Field Service
- Spontaneous
- IT
- Facilities

0% 20% 40% 60% 80%

Sutlief, SU-F-T-462 (2016) (poster)

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Illawarra CCC Online Helpdesk

- Implemented an Online Helpdesk
- Users select faults in a series of dropdown menus
- Enables free-text entry and attaching files or images

McNamara et al, JACMP 14:359-367, 2013
ICCC Fault Notification Chain

- Notify appropriate staff ASAP
- Create service request
- Configuration: routing and escalation rules, due dates, and alerts

McNamara et al, JACMP 14:359-367, 2013

ICCC Results

- Consistency and utility of equipment fault information has improved.
- Incorrect categorization of faults can skew reporting trends and mask common problems.
- **An online helpdesk does not replace the need for communication among staff and with service engineers.**

McNamara et al, JACMP 14:359-367, 2013

Cone Health Cancer Center

Slide courtesy of Benjamin (BJ) Sintay, CHCC
Preemptive maintenance

- Using SPC to predict component failure or system dysfunction in order for maintenance to be performed prior to the actuation of interlocks.
- Forty-five synthetic errors/changes were introduced to test the effectiveness of the initial chart limits.
- Forty-three of the forty-five errors (95.6%) were detected in either the Individual or Moving Range chart for each of the subsystems monitored.

Take-home points

Take-Home Points

- Read the manual
- Document solutions to problems for future reference
- Use periodic quality assurance to anticipate future problems
- Create searchable repositories for machine logs, associated files and images, field service reports, and vendor notifications

References