Fault Trees

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Disclosures



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I am the president of the nonprofit Center for the Assessment of Radiological Sciences, a 501(c)(3) non-profit Patient Safety Organization listed with the Agency for Healthcare Research and Quality and dedicated to improving the safety and quality of radiotherapy.

Learning Objective

To understand the principles of fault trees

FTA in context

Process Mapping helps us to understand the details of the patient's clinical pathway.

Failure Modes and Effects Analysis helps us to prioritize failure modes for further analysis.

Fault Tree Analysis helps us to identify: • possible systemic program weaknesses • where to put barriers and checks.

Quality Management uses these tools to help build a safer system.











- 1. Start with the FMEA Table
 - Use the step as the beginning with the overall failure of that step
 - For example, take a process step of First-day Treatment
 - The failure would be simply treatment failure and the start of the tree would look like this =>



- 1. Start with the FMEA Table, enter the overall failure of that step.
- 2. Then, also from the FMEA, enter the major potential failures



Fault Tree Construction

- Start with the FMEA Table, enter the overall failure of that step.
- Then, also from the FMEA, enter the major potential failures.
- 3. Enter all the ways that the failure could occur =>



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- Then, also from the FMEA, enter the majo potential failures.
- 3. Enter all the ways that the failure could occur.
- 4. Add the causes for the failure mode=>



Fault Tree-failure in isocenter placement

- Start with the FMEA Table, enter the overall failure of that step.
- Then, also from the FMEA, enter the major potential failures.
- Enter all the ways that the failure could occur.
- 4. Add the causes for the failure mode.
- 5. As necessary, keep working backwards to further causes until the causes are out of your control.



Common Causes

- Common causes are causes that appear on different branches of the fault tree.
- A common cause can propagate along multiple pathways
- Common causes indicate particularly hazardous causes.
- They may simply be a cause, e.g., "lack of training" showing up often, even though each may be a different training lacking.

Simple Common Cause





ANDs and ORs

- OR gates indicate increased hazard because any of the input causes lead to the failure.
- AND gate indicate protection since *buth* inputs need to fail for the process to fail.
- Let's look at the simple example again =>







How to Use a Fault Tree?

- Start with the branches of the fault tree with either highest PRN or S.
- Wherever you start, you will consider all the possible failure modes until prevention is not worth the resources.
- So, if you are off in your values for the FMEA, not a big deal.
- Pay particular attention to common causes.

Generalization about Fixes

The prevention of events can be by Eliminating progenitor causes, OR

By interrupting the propagation.



Interventions in Order of Preference

- 1. Redesign
- 2. Fix technical problems
- 3. Fix environmental problems
- Assure key core component
- 5. Perform robust commissioning of equipment and procedures
- 6. Insert QA or QC into the process

Summary

- Fault trees help understand the propagation of failures
- Later we will see that they help in determining actions to reduce hazards