Why Errors Happen

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With statistical data from
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The Error Prone Department

- No written procedures
- No incident reporting system
- Errors are covered up
- Checks are all based on tick lists
- Head of Department prides himself in letting junior staff have freedom to invent new approaches
- Staff who make mistakes are supported
The Error Free Department

- All work follows detailed written procedures
- Perpetrators of errors are disciplined
- Checking follows rigid protocols with several checkers checking the plan
- At each stage in the process data are checked before passing on to the next stage
- Staff specialise in narrow areas so that they can be fully trained
- New techniques are only introduced once all uncertainties have been eliminated
- Staff must carry out many practice plans before they are signed off to do real plans
- Staff have a healthy distrust of computers

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Why might this also be error prone

- All work follows detailed written procedures
- Perpetrators of errors are disciplined

**Staff do not dare question what is done**
**Staff will be tempted to cover up their mistakes**
**Learning from near misses will be lost**

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The Heinrich Triangle

- 1 Major Incident
- 29 Minor Incident
- 300 Near Misses
Why might this also be error prone

• Checking follows rigid protocols with several checkers checking the plan

It has been shown that when people know that another check will follow they are less diligent
Checkers do not look for the unexpected
Danger of involuntary automaticity

Why might this also be error prone

• At each stage in the process data are checked before passing on to the next stage

This is generally regarded as good practice but there is a danger that other staff will be reluctant to question data they are presented with because it will be seen as criticising another staff group
Why might this also be error prone

- Staff specialise in narrow areas so that they can be fully trained

  Staff may become bored with their work and therefore more error prone
  Training for a limited group of tasks is unlikely to encourage staff to think or to prepare them for the unexpected

Why might this also be error prone

- New techniques are only introduced once all uncertainties have been eliminated

  This denies patients the opportunity to benefit from new techniques
  Morale is likely to be low
Why might this also be error prone

• Staff must carry out many practice plans before they are signed off to do real plans

  This is good practice but doing real plans introduces the unexpected so vigilance remains necessary

Why might this also be error prone

• Staff have a healthy distrust of computers

  Computers can lead to a single mistake being repeated many times
  However, there is overwhelming evidence that with appropriate QA computers reduce errors especially if changes by humans are minimised
How error prone are we?

Data from 2003 to 2012

- Number of courses: 53,971
- Number of fractions: 761,797
- Number of radiation errors: 630
- Percent errors per course: 1.2%
- Percent errors per fraction: 0.1%

12 years of incident data
2000 to 2012
Where do errors occur?

<table>
<thead>
<tr>
<th></th>
<th>Simulation</th>
<th>Trit Planning &amp; Cals</th>
<th>Data entry/Transfer</th>
<th>Treatment delivery</th>
<th>Total</th>
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<td>32</td>
<td>85</td>
<td>69</td>
<td>89</td>
<td>275</td>
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<td>July 2011 - June 2012</td>
<td>4</td>
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Process in which errors occur

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Key issues

- All humans are error prone
- Errors are almost invariably due to system failures
  Failure of defence in depth
- Poor communication especially between staff groups
- Involuntary automaticity
- Failure to test new techniques by measurement
- Tiredness

Glasgow 2006

All comments are based entirely on the published report.

The Glasgow incident—a physicist’s reflections.
Mayles WP
Glasgow 2006

- Parallel opposed treatment to head
- Prescribed 35 Gy in 20 fractions
- Planning computer told 35 Gy in 21#
  Daily dose 1.67Gy 91 MU per field
- MUs calculated were assumed to be for 1 Gy
- MUs delivered 160MU to give 1.75 Gy
- Stopped after 19# Dose 55.5 Gy
  Equivalent to 67Gy for alpha/beta=3

What went wrong

- This was an unusual treatment with only a few people trained to do the planning
- Staff are reluctant to refuse to do a plan when they believe that a patient will have to wait for treatment
What went wrong

• The planner had not been fully trained to do this sort of plan and the only person able to check the plan had to help
• A checker is probably less likely to spot a mistake than if the same person was doing the plan from scratch
• An inexperienced person doing a plan is more likely to make a mistake than an experienced person
• A second independent check may be appropriate

What went wrong

• The department had changed the way it worked by introducing direct MU data transfer from the planning system
• Whole CNS treatments are very complex and the effort involved in fully electronic transfer is considerable
• As a result two systems were in use at the same time
What went wrong

• A dose check was carried out when the plan left the physics department but it was apparently not noticed that the incorrect dose had been entered
• Was the method of checking applied adequate to prevent involuntary automaticity?

What went wrong

• The plan was passed to the Radiographers who thought (not unreasonably) that because this was not following the new system of digital data transfer the old system of the planners giving the MUs for 1 Gy was being used (as had apparently been agreed)
• Communication and the interface between groups has been identified as a potential source of error
• The Stoke report said: “One person, usually a medical physicist, should have overall responsibility for all aspects of the dosimetry system”
What went wrong

• Have we lost the skill of having a feel for the right MUs?
• The average width of a head is 15 cm
• As a rule of thumb the attenuation of a 6MV beam is about 3% per cm so the beam will be attenuated by about 16.5% corresponding to 5.5 cm
• It follows that 91 MU is likely to deliver about 76 cGy at the centre of the head and the dose delivered from both beams will be about 1.5+ Gy – not 1 Gy
• This should be second nature to us – but it is not to me and probably not to most of you!

What went wrong

• Was there an independent MU check?
• According to the report there was
• But this was not a check of the MU’s that were set on the machine
What went wrong

- In vivo dosimetry was not carried out
- However, if the expected dose was calculated from the MUs rather than from the intended dose the error might not have been spotted

Some other questions

- Are staff encouraged to be suspicious of information provided to them?
- Do staff understand the processes being carried out by other staff groups?
- Are staff open to being questioned by others or does a physicist bristle when asked to explain why he has done something by a radiographer?
- Is there adequate staffing?
- How do we identify a situation which is a change in practice than needs to be evaluated?
Summary

• All humans are fallible
• Computers will do what humans tell them
• A good checking procedure will require the checker to engage positively
• Too many checks – especially those that just require ticking a box - may be counterproductive
• Phantom measurements are an essential part of the development of a new technique
• Staff should be encouraged to do a reality check using mental arithmetic and common sense rather than being totally reliant on computers