

Improvement Cymru Academy Toolkit Guide



Bowtie Safety Model

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What is the Bowtie Model?

The Bowtie model is a complex non-linear safety model and visualisation tool that can be used to describe an incident in relation to its initial causes, negative consequences and barriers that can be put into place to prevent or control the named hazard. It is called a Bowtie because when completed the diagram resembles the shape of a bowtie. The bowtie shape creates a clear differentiation between the proactive and reactive risks. The diagram has key areas that need to be identified:

1. **Hazard:** The activity, process or state that has the potential to cause harm.
2. **Top event:** The point chosen in time when control over the hazard is lost.
3. **Threats:** These are the possible causes for the top event.
4. **Consequences:** These are defined as the unwanted event caused by the top event.
5. **Barriers:** These are defined as measures taken to prevent, control or mitigate events
6. **Escalation factors:** These are defined as a condition that defeats or reduces the effectiveness of a barrier.

There can be one or more threats, consequences, barriers, and escalation factors.

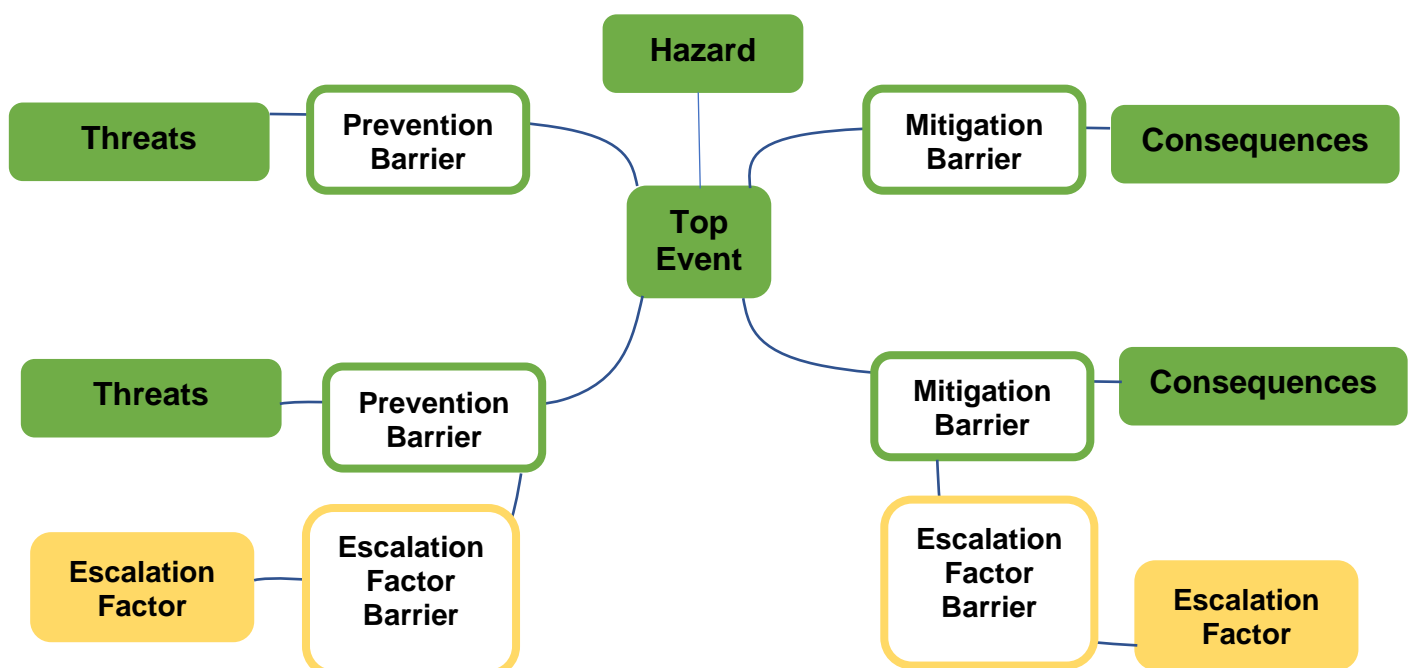


Diagram one shows a Bowtie image.

Rationale

The Bowtie model can be used to understand and manage risks within your processes in a visual and systematic way. It can be used to identify and assess risks retrospectively or prospectively. Because it is visual, it is a good tool for communicating the risk and controls to relevant stakeholders. It can facilitate evaluation of the effectiveness and performance of the controls. Identification of measures that will prevent, control, or mitigate against the risks involved with the hazard, supports the development and implementation of improvement actions. Using a Bowtie can improve organisational safety culture and provides a culture of learning and improvement in patient safety.

Background

The Bowtie safety model is thought to have first originated in oil and gas companies as a way of communicating and managing the risk of major hazards. Since then, the model has been adopted by other industries such as the aviation industry and healthcare industry and organisations. For example, the United Kingdom Health and Safety Executive (HSE) and the International Civil Aviation Organisation (ICAO). The Bowtie model is recognised as a standard for risk management and assessment by international standards and guidelines.

When to use the Bowtie Safety Model

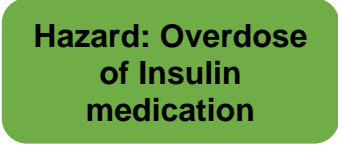
You could use the Bowtie model to look at incidents retrospectively to address ways to mitigate against the cause of the incident to make improvements to processes. The Bowtie model is useful when taking a proactive approach to risk to identify and assess the risks within your process and find ways to prevent and control them.

How to use the Bowtie Safety Model

A Bowtie will help you understand, analyse, and communicate risks to your stakeholders. Before you begin to create a Bowtie diagram you will need to define the scope and context, identify the hazard and top event you want to focus on and ensure that you have all relevant stakeholders to help create the bowtie diagram.

Step 1: Identify and define the hazard.

The hazard is the foundation of a Bowtie diagram and sets the scope and context for the Bowtie. The hazard is a source of potential harm and can lead to an unwanted event e.g. Insulin overdose. Insulin is a medication that is used to help lower blood glucose levels in people with Type 1 diabetes. The unwanted event could be that too much insulin has been administered to the patient.



**Hazard: Overdose
of Insulin
medication**

Diagram 2 show an example of overdose of insulin showing the hazard.

Step 2: Define the top event.

The top event is the unwanted event that could potential occur after a hazard is realised. In the example above, the hazard is the administration of insulin medication, and the top event is hypoglycaemia, which is when a person's blood glucose levels become too low. This could have serious consequences which will be addressed in the later steps of the Bowtie.



**Hazard: Insulin
overdose**



**Top event:
Hypoglycaemia**

Diagram 3 shows an example of overdose of insulin showing the hazard and top event.

Step 3: Identify Threats that are credible to the top event.

To identify all the possible threats, you will need all relevant stakeholders to brainstorm the possible threats. There can be more than one threat. Possible threats of insulin overdose include miscalculating for carbohydrate content, missing, or

delaying a scheduled meal following injecting insulin. There are some possible threats listed in the example below, however there are more possible threats that for the purpose of displaying the diagram on this toolkit are not included. When creating a Bowtie diagram all possible threats should be included within the diagram.

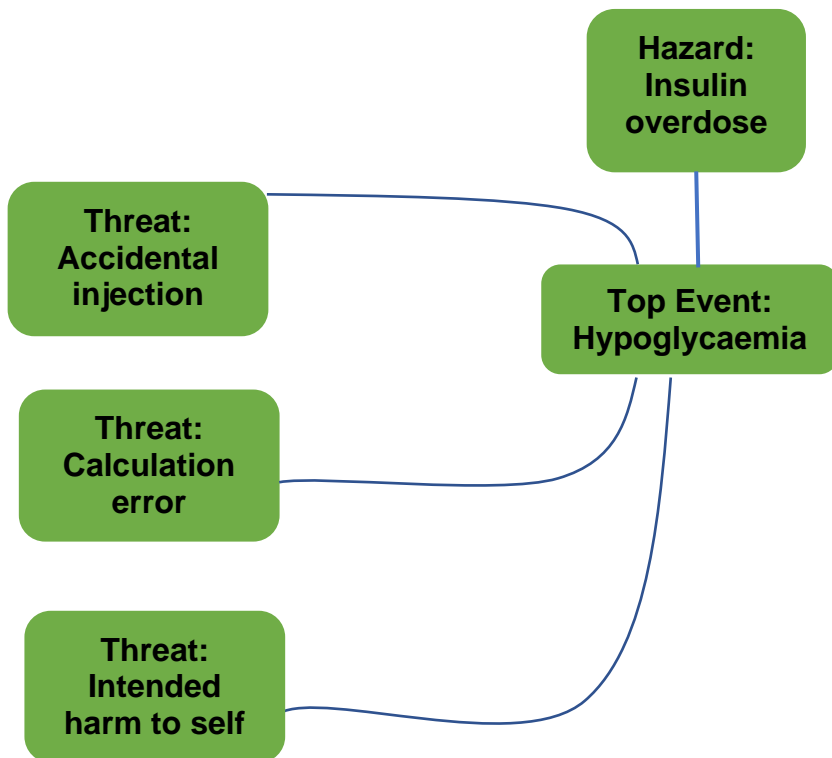


Diagram 4 shows an example of overdose of insulin showing the hazard and top event and possible threats.

Step 4: Identify any consequences of top event.

To identify all the possible consequences, you will need all relevant stakeholders to brainstorm the possible consequences. A consequence is an outcome that follows the top event. Taking too much insulin can have serious consequences, including confusion, seizures, coma, dizziness, headaches, and death. There are some possible consequences listed in the example below, however there are more possible consequences that for the purpose of displaying the diagram on this toolkit are not included. When creating a Bowtie diagram all possible consequences should be included within diagram 5 as shown below.

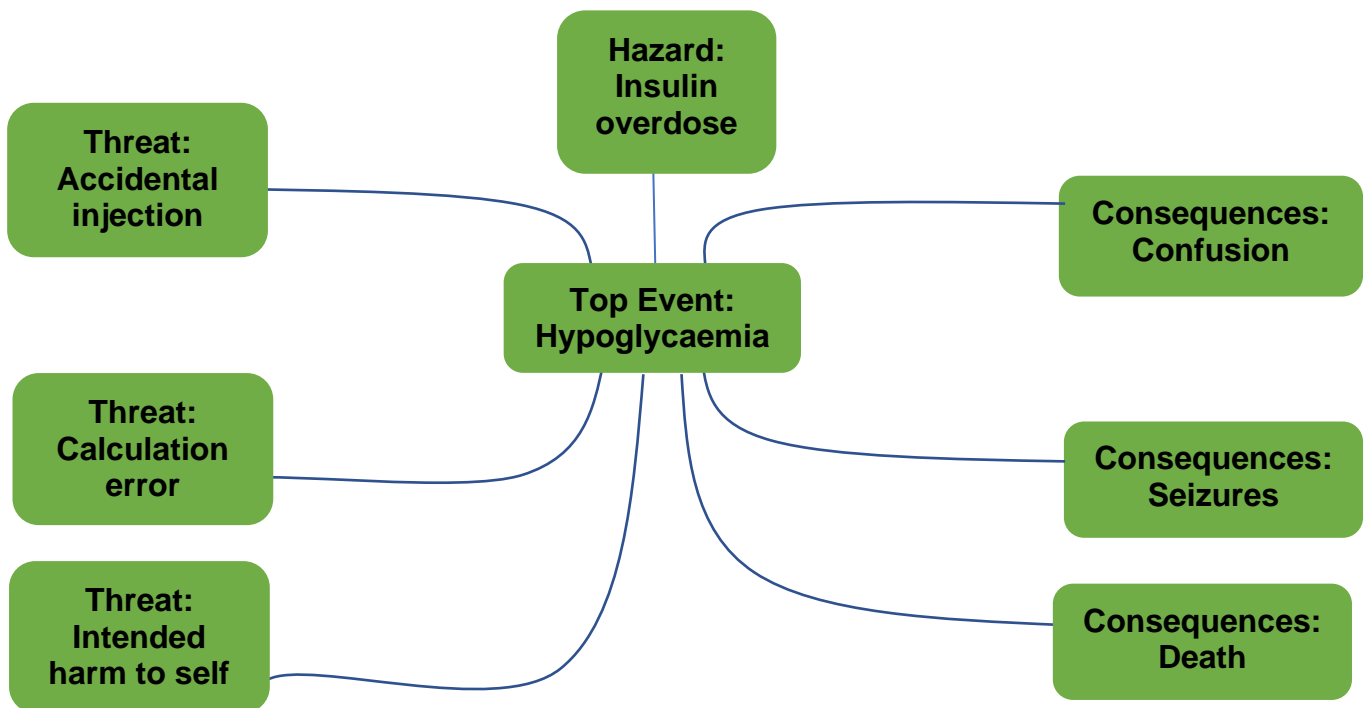


Diagram 5 shows an example of overdose of insulin showing the hazard and top event, possible threats, and consequences.

At this point, you should have a clear understanding of the risk scenarios and what needs to be managed. The hazard, top event, threats, and consequences give an overview of what we do not want to surround a task. Each line in this diagram represents a different potential scenario.

Step 5: Identifying barriers.

A barrier is sometimes referred to as a control. Barriers interrupt a scenario from occurring so that threats do not result in the top event and do not escalate to unwanted consequences. Once a barrier has been identified, you will understand how to manage the risk. It is good practice to brainstorm potential barriers with your stakeholders. There can be more than one potential barrier for each threat and consequence as shown in diagram 6.

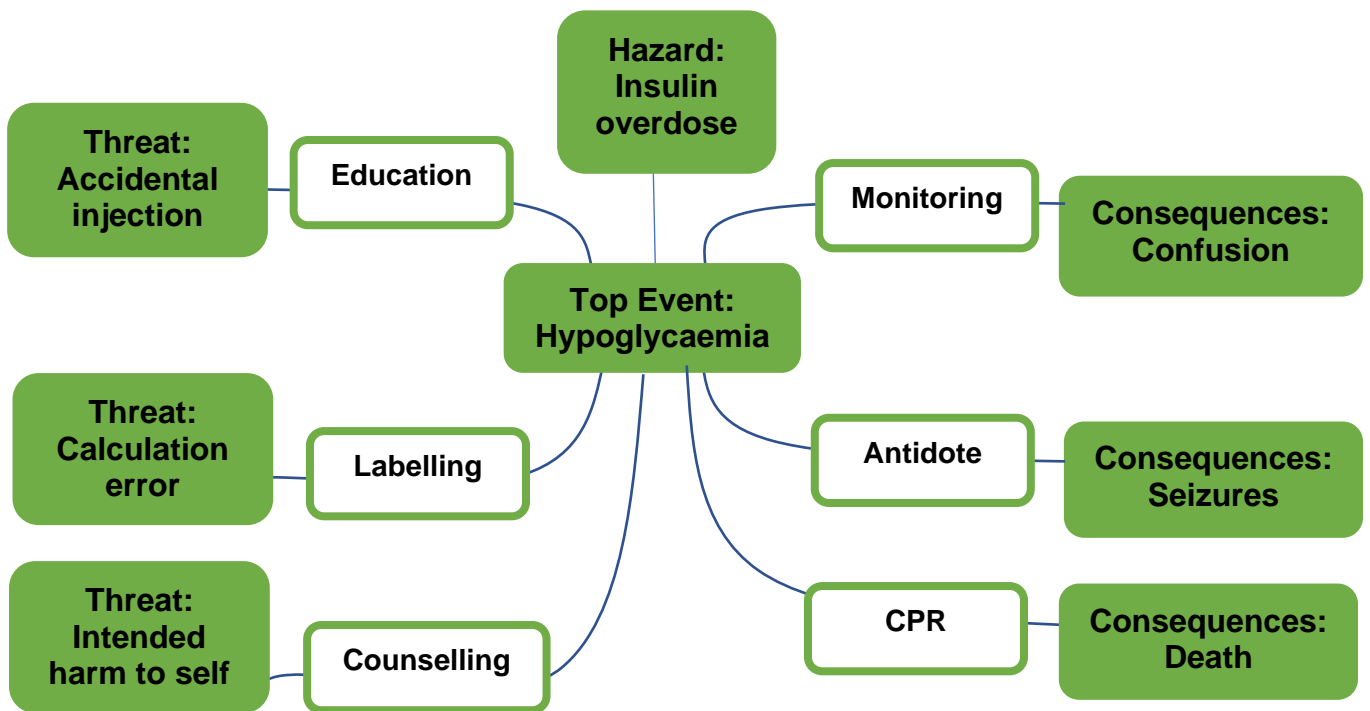


Diagram 6 shows an example of overdose of insulin showing the hazard and top event, possible threats and consequences and mitigation barriers.

Step 6: Identify escalation factors.

Escalation factors are also known as degradation factors and are anything that could cause the effectiveness of a barrier to reduce or become defeated. Escalation factors are used to help understand why barriers fail. Again, it is important that you brainstorm within your team to understand why each identified barrier could fail. For example, the threats, education could fail because there is a lack of awareness of the available training. Diagram 7 includes potential escalation factors. You could have more than one escalation factor for each of the barriers as shown below.

Step 7: Identify escalation factor barriers.

When you have identified the escalation factors, you need to put barriers in place to prevent them from happening. For example, a barrier to prevent lack of awareness could be to implement effective communication tools or to promote a culture of learning and improvement. Using standard units, colour codes, and clear legible fonts can help with labelling issues.

You will need to put all escalation barriers into the Bowtie diagram but for the purposes of this toolkit only one is listed in the diagram.

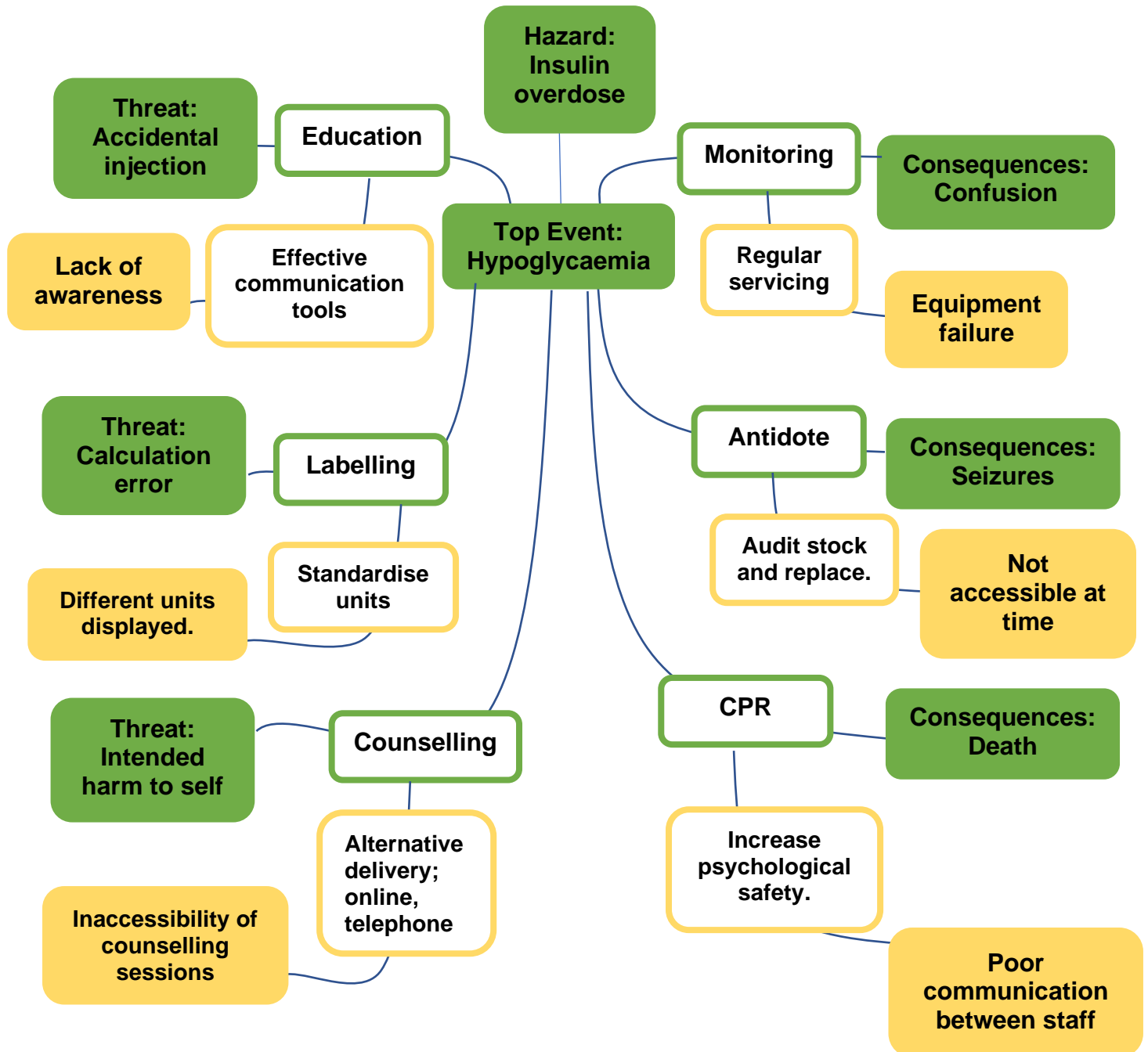


Diagram 7 shows an example of overdose of insulin showing the hazard and top event, possible threats and consequences, mitigation barriers and escalation factors and escalation barriers.

What Next?

You can identify risks using incident reporting or you could perform a Failure Modes and Effects Analysis (FMEA) (See our [FMEA toolkit guide here](#) for more information), choose a risk in the process, and then use the Bowtie to map out the threats, consequences, escalation factors and the barriers to prevent these risks from happening.

Helpful tips

The Bowtie safety model is a visualisation tool that allows you to see the risks and how you can manage them. You should use a structured approach to develop a Bowtie diagram starting with the hazard and the top event and then move onto identifying the threats, consequences, barriers to mitigate them and then the escalation factors and barriers. Ensure you engage with all stakeholders involved in the hazard you have define and encourage active participation and discussion to understand all the possible threats, consequences, escalation factors and barriers (See our [Involving Others Toolkit Guide here](#) for more information). When you have completed the Bowtie diagram, prepare an action plan, and assign responsibilities to people or job roles for implementing and monitoring the barriers to the hazard.

Additional Resources

If you are interested in learning more about how improvement practices can benefit your workplace, we offer a range of training courses. Visit our website for more information. <https://phw.nhs.wales/services-and-teams/improvement-cymru/improvement-cymru-academy/> or email us improvementcymruacademy@wales.nhs.uk to find about the improvement courses we offer.

References

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