Understanding and responding when things go wrong: key principles for primary care educators

Dr Duncan McNab

GP Associate Adviser (Safety and Improvement)[1] and PhD Student[2]

Dr Paul Bowie[1, 2]

Programme Director[1] and Honorary Senior Lecturer[1]

Dr Alastair Ross[3, 4]

Lecturer in Behavioural Science[3] and Human Factors lead[4]

Prof Jill Morrison

Professor of General Practice and Primary Care[2]

[1]Medical Directorate, NHS Education for Scotland, Glasgow, UK
[2]Institute of Health and Wellbeing, University of Glasgow, UK
[3]Dental School, Glasgow University, UK
[4]Centre for Applied Resilience in Healthcare, St Thomas Hospital, London, UK

Corresponding author:
Dr D McNab
Associate Adviser (Safety and Improvement)
Medical Directorate
NHS Education for Scotland
2 Central Quay
GLASGOW, Scotland, UK
G3 8BW
Email: duncan.mcnab@nes.scot.nhs.uk
Telephone: 0141 223 1450

ABSTRACT

Learning from events with unwanted outcomes is an important part of workplace based education and providing evidence for medical appraisal and revalidation. It has been suggested that adopting a 'systems approach' could enhance learning and effective change. We believe the following key principles should be understood by all healthcare staff, especially those with a role in developing and delivering educational content for safety and improvement in primary care.

When things go wrong, *professional accountability* involves accepting there has been a problem, apologising if necessary and committing to learn and change. This is easier in a '*Just Culture'* where wilful disregard of safe practice is not tolerated but where decisions commensurate with training and experience do not result in blame and punishment. People usually attempt to achieve successful outcomes, but when things go wrong the contribution of *hindsight and attribution bias* as well as a lack of understanding of conditions and available information *(local rationality*) can lead to inappropriately blame '*human error'*. *System complexity* makes reduction into component parts difficult; thus attempting to 'find-and-fix' malfunctioning components may not always be a valid approach. Finally*, performance variability* by staff is often needed to meet demands or cope with resource constraints.

We believe understanding these core principles is a necessary precursor to adopting a 'systems approach' that can increase learning and reduce the damaging effects on morale when 'human error' is blamed. This may result in 'human error' becoming the starting point of an investigation and not the endpoint.

Introduction

When things go wrong in many aspects of everyday life 'human error' is often cited as the 'cause'. This is true in highly hazardous industries, including healthcare, where media headlines are often quick to blame human error as the 'cause' of any safety-related incidents or accidents. It is often presumed that if there has been no technical malfunction, or natural disaster, then the human must have caused the accident.

In 2000, the seminal report, *An Organisation with a Memory*, was published by the Department of Health. [1] Central to the report's key recommendations was that we should move away from blaming individual human error as a primary 'cause' of adverse healthcare events (events that resulted in preventable harm to patients) and adopt a 'systems view' when investigating these types of incidents. More than a decade on, this move towards a new way of thinking and acting has proved challenging and progress remains slow – particularly in updating and integrating related curricula to support education and training of the NHS workforce.

As one way of taking this agenda forward, and consolidating the need for a fundamental understanding of the factors that give rise to healthcare outcomes, good and bad, we firstly propose a basic 'package' of ideas and concepts that need to be grasped (and arguably 'believed') by clinicians, managers, senior executives, educators, regulators and policymakers before significant progress can be made in improving the quality and safety of patient care. In this article, we argue that it is imperative that those involved in patient safety education in primary healthcare accept and adopt the key fundamental principles outlined to aid this progress. [Box 1]

Involvement in patient safety work and education

Like all clinicians, the core work of qualified GPs and specialty trainees is obviously focused on improving the health and wellbeing of patients, while simultaneously keeping them safe from avoidable harm associated with clinical interventions and care processes. However, sometimes things do go wrong and when this happens the GP team is expected to act accordingly, often undertaking Significant Event Analyses (SEA) to investigate such patient safety incidents (events where patients suffered unintentional but preventable harm or had the potential to do so, as part of their healthcare management, whether physical or psychological and no matter how minor). [2] SEA is assumed to help teams a) understand why the event happened and b) implement change to minimise the risks of recurrence. In the UK, completion of written SEA reports is a mandated component of workplace based assessment for general practice specialty trainees. [3] Similarly, it is

also a requirement for qualified GPs as part of the appraisal and revalidation process. [4], and is sometimes incentivised locally by health authorities.

Whilst reflecting on (and learning from) patient safety incidents is considered a key part of professional development and improving the quality and safety of care, it has been suggested that both learning and improvement could be more objective, meaningful and effective, if we move away from focusing on individual human error (and its potential corollary – 'blame'). The evidence suggests many do not give sufficient attention to broader systems influences, but overly focus on individual performance and behaviours without appreciating the wider human interactions and work environment factors that combine and impact to contribute to safety incidents. A recent review demonstrated that 'human error' was the most commonly cited contributing factor in SEAs conducted by GP teams, being attributed to around a third of all events analysed [5].

When things go wrong – Balancing Safety and Accountability in a 'Just Culture'

To those of us working in patient safety education and research in primary care, it often seems that 'accountability' can be misunderstood by clinicians and managers in the context of something going wrong. Frequently it appears to take on punitive overtones, and may be associated with finding someone to blame (or self-blame). Where this organisational or team 'blame culture' is prevalent learning and change is not maximised (and future opportunities for learning are diminished when others see the consequences).

In reality, individual professional accountability actually involves accepting that there has been an error, raising the issue, apologising to those concerned, and committing to learn and implement any necessary change. Thus moving from a 'blame culture' to an 'open' or 'just' culture. This does not mean some unsafe acts do not deserve sanctions. But the culture is that people (patients, families, clinicians and managers) want openness, transparency, and fairness. Being accountable (professionally and organisationally) rather than indulging in the 'blame-game', therefore, is an important precursor to analysing and learning from adverse events. In this way 'human error' often becomes the starting point of the analysis of a significant event rather than the end point.

If the idea is for GPs and speciality trainees to learn from patient safety incidents to make healthcare safer then it seems self-evident that we need to move from a narrow focus on what people did and did not do, to a wider one which takes into account the demands of the situation, the often limited resources at their disposal, what they were trying to achieve and why, what other people have suggested in that area of operation, etc. People will generally accept being held accountable for

their actions, and commit to learning and improving, if they know that all the various influences on outcomes will be genuinely taken into account. This 'Just Culture' has been defined as:

"...a culture in which front-line operators and others are not punished for actions, omissions or decisions taken by them which are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated. [6]

The development of such a Just Culture requires commitment of all levels of the organisation: GPs, managers and the whole team. Staff training that commences at induction (including speciality trainee induction) is essential and should enshrine the four key principles related to situations where something goes wrong: to report, disclose, protect and learn. [7; Box 2] The involvement of frontline clinical and administrative staff in the analyses of incidents and the development and continued success of a Just Culture is vital. They are the experts in how everyday work is actually conducted and can help managers and other staff involved in the analysis understand local system contexts, demands and constraints which influenced why decisions were made.

A properly functioning Just Culture requires as many differing perspectives as possible to be brought to bear on an event or process under scrutiny. The 'view from below' (often coming from those directly involved in events) is as vital as the 'view from above' from those involved in the management and clinical governance of practices or organisations. In a functioning Just Culture frontline staff will feel able to explain the conditions of work that led to decisions being made, and such accounts should always be solicited prior to analysis of incidents. These accounts should not be used to search for protocol violation and assign blame but to try to understand the dynamic interactions and variations that characterise healthcare work systems. Decisions in context are very different from those that might be desirable under 'ideal' or sterile conditions. This field of inquiry, trying to understand actions on the ground in context, is known as the examination of 'cognition in the wild' [8].

In summary, it is vital to a) adopt a systems perspective which minimises the focus on discrete individual behaviours and discourages the propensity to blame; b) examine actions in contexts which are often complex and require difficult weighing up of options and goals; and c) hold people accountable in an open and transparent fashion whilst promoting and maintaining a shared goal of system improvement (amongst care teams, organisations, accreditation and regulatory bodies) for the benefit of staff and patients alike.

Incident Analysis - The problem with 'human error' and human biases

As stated, if there is no obvious technical, mechanical or organisational problem then 'human error' is often cited as the cause of an incident or accident [9]. There are well documented reasons for this focus on the proximal, active precursors to accidents, in fact such a general bias towards human actions (ignoring system and environmental influences such as protocols, cultures, interdisciplinary boundaries etc.) is known in behavioural science terms as the 'Fundamental Attribution Error' [10].

Further, hindsight bias applies because the label 'error' is almost always attached once we know the outcome, and this fundamentally affects how we subsequently analyse events. It is easy to analyse significant events and work backwards until someone is found who deviated from protocol or forgot to do something and blame that individual or team for causing the event. It is also easy to assume, in hindsight, that this deviation is the error that caused the adverse event and that this outcome was predictable. However, such judgements are always made after the event with full knowledge of the outcome. In the complex systems that exist in healthcare where the conditions that influence work contexts and interactions are not always immediately visible or fully understood, it is difficult to be sure that a) deviation from protocol resulted in the adverse event or b) the event would not have occurred if a different course of action had been taken [11].

Analysing events retrospectively can also lead to influence from other human biases. If the event outcome was considered 'bad' then it is presumed that the 'cause' is equally bad. If the unwanted effect was minor, a simple cause may be promoted; whereas if it was more serious a more complex explanation may be sought. It is easy to ascribe causes to events that were closer in space and time to the unwanted event or to people who are more memorable to those involved. This principle of the 'salience' of possible explanations may result in the blaming of frontline workers who are visible and present in the vicinity of patients prior to an event that caused harm. [12]

As McKay et al (2009) found, GPs are often ready to 'take the blame' when something goes wrong. [5] This is often due to these inherent biases. For example, often the last person to see a patient before some serious event 'takes the blame'. Consider this scenario: a patient with depression sees several GPs over the course of a year. Shortly after seeing one doctor he commits suicide. This doctor may 'take the blame' and review his/her own actions and conclude that in retrospect there were a lot of risk factors for suicide and they should have predicted this and acted accordingly (hindsight bias). Family may also be ready to blame the doctor as they were the last person to see them (this face-to-face interaction, close in time to the outcome, is therefore highly salient). As the outcome was so 'bad' the actions or inactions of the GP, no matter what they were, will be viewed as 'wrong'- how can they not be so, when the patient sadly came to harm? One can imagine that recommendations might include training in suicide awareness and/or consultation skills, or a review

of the management of patients with mental health problems to improve the performance of the GP (and the wider care team). However, the complexity of dealing with several problems during a ten-minute consultation is less likely to be fully considered, nor the fact that appropriate referral and safety netting (with family involvement) had actually taken place. Continuity within the practice, the ability to book longer appointments and the interface with colleagues in mental health services, are also less attractive (though no less plausible) as explanations for such events but may not be considered, especially where emotions run high.

Despite the rhetoric of the move towards a 'Just Culture' in the NHS, many organisations (and SEA attempts) still see blaming 'human error' (either directly or indirectly) as an easy 'fix'. If an investigation concludes that one person or team is to blame for a particular adverse event, then it seems easy to 'fix' the problem. Re-training, more education, increased control of work processes, unwarranted disciplinary action or even dismissal are seen as straightforward ways to sort the problem. Reports can be produced that detail the cause of the event and the actions that have been implemented to prevent it re-occurring. This may appease organisations, regulators, media and the public, but may not solve the underlying problem and so learning is limited and recurrence remains likely.

Local rationality

When investigating events, we not only know the outcome but we have access to other information that would not be available to those involved in the incident. Psychologists suggest that decisions are made to achieve success based on the information that is available to the frontline worker at the time. This is termed local rationality. When analysing events retrospectively it is tempting to presume that all the information available to the investigators was available to those who made the 'error'. Exploring the decisions other staff with similar experience would have made in similar situations can be helpful but this is still influenced by hindsight bias. [13]

Viewed from this perspective, the presence of a 'blame culture' and the focus on 'human error' are counterproductive to learning and improvement. The care team and the practice's ability to learn from adverse events and from near misses is reduced. Incidents are not reported or raised because front line workers know they will be judged not by their very real and well intentioned attempts at the time in uncertain conditions, but by the standard of what they 'should' have done based on a knowledge of outcomes that have now crystallized.

Understanding everyday work - System complexity and performance variability

The application of a 'systems approach' is considered essential to improving patient safety efforts [1] and is a goal in the application of Human factors/Ergonomics (HFE) approaches in the workplace. [14] Initially it requires definition of the work systems and understanding of the complex interactions and context within which work is undertaken. Systems are often broken down into their component parts in an attempt to understand functioning, but a holistic view of system functioning encompassing the varied interactions between components is a core HFE principle.

So, what do we mean by a 'system' and by 'complexity'? At the outset, it is important to understand what these terms actually mean. A system can be described as:

"*A set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviours, often classified as its 'function' or 'purpose'*" [15]

An example of a GP prescribing system is described in Box 3. A process is similar but involves the activities involved rather than the components and can be defined as:

"A systematic series of actions directed to the achievement of a goal." [16]

Parts of the system may be obvious (for example the computer that prints prescriptions) but other parts are less obvious (for example the dialogue between the patient and doctor before the prescription is printed). It is tempting to imagine the everyday systems that we work within operating in a logical, linear manner but this is rarely the case in healthcare. Although the described prescribing system appears to progress in a logical, stepwise, chronologically simple fashion, in reality many feedback loops are present such as discussion between the GP, the administrative staff, the patient and the pharmacist before prescriptions are signed. Also, healthcare systems do not function in isolation rather they work within other systems and are influenced by ever changing conditions with poorly defined boundaries.

This has led to healthcare systems being described as 'complex socio-technical systems', characterised by multiple interactions between various components, both human and technological. [17, 18, 19] Decisions may need to be made with imprecise information and actions may need to vary dependent on conditions to ensure successful and safe outcomes. For example, clinicians may elect to continue medication while awaiting monitoring test results in order to ensure no harm comes to the patient. The conditions in the system can change rapidly. Demand may increase due to holidays or due to media reports relating to medication warnings. Capacity can change due to staff absence, guidelines can change and importantly the wishes, the understanding and the health of patients can change and influence how we complete prescriptions. Due to this variability clinicians and administrative staff constantly adjust their performance and often stray from standard practice

or protocol in an attempt to match the demand. These adjustments may be seen as 'violations' when viewed retrospectively but they are essential, ubiquitous and usually result in successful outcomes. However, adjustments are approximate and so also result in unsuccessful outcomes. Trade-offs are another vital part of working in complex systems. One of the most recognised trade-offs is the efficiency-thoroughness-trade-off. This entails sacrificing task thoroughness for efficiency. An example would be signing large numbers of prescriptions every day. The thorough (or safer) action would be to review the notes of many patients and arrange telephone or surgery review for many others; the efficient action is to sign them (otherwise other necessary care work is compromised). Performance variability and trade-offs are essential for successful operation in complex systems; they are everyday work. In the real world of work, performance variability, multiple interactions and environmental influences result in systems that are difficult to fully specify, break down into their component parts and comprehensively understand – therefore 'cause and effect' become less obviously related. [20].

Accident models – The problem with 'root cause' and linear thinking

Various conceptual models have been used in patient safety to aid analysis of incidents. Heinrich's domino model suggests a simple linear relationship between cause and effect that allows an investigator to work backwards from the incident and find the upstream cause. The model is rarely valid in the complex systems in healthcare. [21; Figure 1] Reason's 'Swiss Cheese' model describes how a combination of latent errors may allow active errors to cause accidents. [13; Figure 2] Although this model has been successful in moving focus from a single cause it has been criticised due to the fact it does not recognise the multiple interactions between components and barriers, it displays barriers being violated in a linear manner and can still lead to the blaming of those responsible for active or latent errors. [22, 23]

Using these conceptual models, traditional incident investigation techniques have worked backwards from events to find the 'root causes'. Changes are then made to improve the functioning of this component, thus expecting the system as a whole to improve. This 'find and fix' approach often results in events reoccurring. [24] Maximising the performance of each component in the system is not guaranteed to increase the overall performance of the system. If a systems approach is adopted, performance of components is optimised (not necessarily maximised) to enhance system performance. For example, in the prescribing system described there may be many different interactions between various people and different technologies. Maximising one part, for example how requests are received (through email or telephone), may not improve overall system

functioning and indeed may reduce functioning as the timing of demand may change and affect flow of work.

Moving forward – a systems approach

Whole hearted adoption of these core principles at an individual and organisation level is necessary if our practice of incident investigation, and indeed all patient safety improvement work, is to mature towards a systems approach. There are many complicated methods available to help teams take a systems approach – but you do not need to be an expert in systems thinking to move towards a systems ideology. [25]

A systems approach involves three main principles:

- The first is attempting to understand the *interactions* and relationships between components and how these contributed to the incident or accident. Change is implemented by considering these interactions in an attempt to improve the overall performance of the system.
- The second principle is the use of *multiple perspectives*. Systems functioning and relationships between components appear different to different people; indeed interactions change frequently. The administrative member of staff will have a different view on how the system actually works compared to the patient, the pharmacist or the GP. The protocol may have been written by a manager or GP and may not reflect how it really works. Frontline staff should be involved in incident investigation but also in protocol design – they are the experts in everyday work.
- The third principle is defining *boundaries*. Systems are subjected to many influences and it is not possible to consider all of these, therefore some sort of boundary needs to be agreed. Often in general practice, the boundary is defined as the practice building although can often involve allied health professionals, pharmacies, social work and secondary care. When adopting a systems approach, an agreement on boundaries needs to be made on a case by case basis in order to maximise learning. All functions that are essential for the overall purpose of the system under investigation should be included within the boundary. If the practice wishes to only examine their own part of the prescribing system, then the boundary is set as the patient and the practice but if the role of the pharmacy was important in an incident then the boundary needs to include the pharmacy.

Various conceptual models are available to aid the adoption of a systems approach. The scientific discipline of Human Factors/Ergonomics has recently developed the SEIPS 2.0 model. [26; Figure 3]

This is based on a combination of the workplace being illustrated as a socio-technical system and Donabedian's structure, process and outcome model but shows how various components can interact in healthcare systems and impact on performance and well-being. Moray's Onion model (see previous article by Bowie and Jeffcott) similarly shows the various layers involved in the system. [27, 28] Enhanced SEA employs a simplified model that directs investigators to consider the interactions between people, the activities they are performing and the environment in which they are performing them. [29] A recently published white paper from the air traffic control industry entitled 'Systems Thinking for Safety: Ten principles' describes ten principles that can be used to aid understanding of systems. [6; Box 4] These principles may help those working in healthcare to understand and apply a systems approach. It is not clear if these principles can be applied to everyday general practice, or wider healthcare, but many of the themes have been considered in this paper. Further research into their development and application in primary care is underway.

Conclusions

At a fundamental level, progress on improving the quality and safety of patient care and related education and training will always be hampered if the workforce does not have a basic understanding of how outcomes emerge. A move from searching for simple 'root causes' such as human error to accepting multiplicity of cause is vital to maximise learning from investigating patient safety incidents. Educators should understand that frontline staff need to be involved in all quality and safety efforts to ensure that multiple perspectives are considered. This is only achievable if they feel safe to do so, and the adoption of a Just Culture that encourages accountability rather than blame is embedded. Frontline staff also can explain local rationality and why performance variability is essential to ensure successful system functioning. An understanding of the interacting complexity of healthcare systems will aid the primary care workforce and clinical educators in adopting these principles.

To maximise learning and change from investigating patient safety incidents these principles need to be understood, accepted and implemented by all involved in moving the safety agenda forward, but most importantly by frontline practitioners and those responsible for their education and training. They need also to be fully embraced and believed by clinical leaders, senior managers, policymakers and regulators to ensure that staff are supported in endeavouring to move from the 'easy fix' of blaming individual actions taken out of context, or simple protocol violations, to a more complex but more rewarding description of system performance. They act as the necessary building blocks to allow this approach to not only improve system understanding, but also help to improve personal wellbeing, team morale, increase learning and make change more effective.

For this to be consistently achieved these foundational 'first principles' need to be incorporated into all levels of patient safety education for primary healthcare staff, including specialty trainees. The inclusion within the training curriculum may be an important lever for change and for the development of related educational resources to support trainers. Arguably, it is only once these core principles are embedded into the everyday routines of primary care organisations can the true potential of a systems approach to patient safety (and quality improvement) begin to be fully realised. [Box 1]

Boxes and figures

Box 1 - Key patient safety principles

Key patient safety principles	
Accountability	Accept that there has been an error, apologise if necessary and commit, as an individual and as an organisation, to learn and implement necessary change.
Just culture	When responding to patient safety incidents, decisions that are commensurate with training and level of experience will not be punished.
Human error	'Human error' should be the starting point of an investigation and not the end of an investigation.
Hindsight and attribution bias	We are all influenced by biases that affect how we view incidents and the decisions made. These need to be acknowledged and considered when investigating events.
Local rationality	People make decisions with the aim of achieving success that make sense to them based on the information they have available at the time.
System complexity	Systems in healthcare are rarely linear but have multiple complex interactions. Rather than reducing systems to individual components in an attempt to find and fix faulty components a holistic view of system functioning is required.
Performance variability	In complex systems workers have to vary their actions in order to achieve successful outcomes. These variations should not be viewed as violations and lead to blame but should be explored and understood as they are fundamental to successful functioning of complex systems: they are everyday work.

Box 2 – The four key principles of a Just Culture

Just Culture
Report Staff should be encouraged to report adverse events and near misses to allow learning from these events through easily accessible reporting systems. Anxiety for staff that report should be minimised by detailing what will happen to their report, who will see it and what are the consequences of reporting?
Disclose Disclosure involves discussing reports with patients. Disclosure can demonstrate that the practice has taken the event seriously and that change has been implemented to reduce the risk of

recurrence. Disclosure can also reduce the risk of complaint and litigation. Disclosure is recommended by the GMC when there has been patient harm and Duty of Candour legislation is being developed to ensure consistent implementation.
Protect Staff that report or disclose need to be protected and written policies to define this are required.
Learn Staff need to receive feedback and see change in order to believe that the reporting system is functioning and worth continued engagement. Feedback can be local and be at the individual or team level. This may lead to immediate change. Alternatively, a number of incidents may be themed leading to more organisational learning and change may take longer. Lastly, reported incidents may be useful in the wider context and shared between practices. It can be useful for teams to revisit previous investigations of adverse events in order to demonstrate the changes that were implemented. The use of a systems based model can improve the learning from events.

Box 3 - Example of a system -The prescribing system within the GP practice.

This system may involve patients phoning a prescription telephone line and informing a member of the administrative staff which medications they need. This is printed and given to the GP to sign. It is then put in a box at reception for collection by a driver from the pharmacy. This system can be divided further:

- A microsystem may be the discussion between the patient and the member of the administrative staff, or printing of the prescription etc.
- A mesosystem is composed of more than one microsystem and so may be the system within the boundaries of the GP surgery.
- The macrosystem may include not just the GP surgery but also the pharmacy and could be extrapolated to include other practice systems such as appointment booking or other systems relating to prescribing such as health board prescribing advisers, national regulators etc

Box 4 - Systems Thinking for Safety: Ten principles

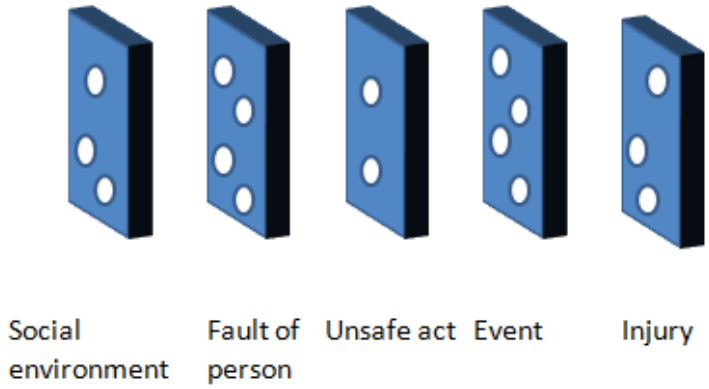
System thinking for safety principle	**Potential application to healthcare**	**Example in Primary Care** A patient telephones for a prescription but the wrong one is printed by the admin member of staff.
Foundation principle – system focus	Consider safety in the context of the system and not isolated individuals. Consider the boundaries of the system to be investigated, identify all those involved. Most problems and most	Involve the admin staff, the patient, the GPs involved – decide if the pharmacy needs to be involved. Look for areas where the system

	possibility for improvement lie with the system.	can be improved to reduce the risk of recurrence rather than blame individual error.
One - Field expert involvement	To understand how work is really performed it is essential to involve those who work on the frontline. In general practice this means involving frontline staff in both the identification and investigation of incidents and the design of change.	Frontline staff can explain what happened, local context, if they often have to vary from protocol and help design changes that are more likely to be successful. The GP can explain the context in which the prescription was signed.
Two – Understand local rationality	Decisions are made based on 'local rationality'. This means the information available to the person who made the decision with the aim of a successful outcome. It is important to explore this with frontline staff when investigating and learning from incidents.	Staff can explain how this happened, what information was available to them and why it made sense at the time – this may be related to a poor telephone connection, noisy environment, interruptions, trying to complete many tasks at once. What information did the GP have?
Three – Just culture	People will not be punished when decisions are made in keeping with their training but wilful violations and gross negligence are not tolerated. This can aid learning and improvement and therefore accountability following incidents.	If staff are immediately blamed, then they are unlikely to co-operate and retraining or trying harder is likely to be recommended. Other learning about the system is less likely. If the GP takes the blame, then other learning is also not achieved. Human error is the starting point of the investigation.
Four - Demand and Pressure	Demands and pressures affect the performance of all staff and needs to be understood to understand how people work within the system.	Was the demand very high that day? Were staff feeling under pressure, were they doing other tasks? Were GPs off – resulting in increased demand on GP time? Was the GP dealing with other time consuming problems?
Five – Resources and Constraints	Success depends on having the correct resources and appropriate constraints, often people have to work in situations where these are not available.	Were some staff absent or had they been pulled away for other jobs? Does the phone system always work well? Is an answer machine used that stops staff questioning patients? Did the GP have time to question the request and information on how to reach

		the patient? Is this routinely collected?
Six – Interactions and Flows	There is a need to understand the interactions between systems. Flow and interactions may not be obvious when a small part of the system is analysed in isolation.	Were staff having to cover other tasks? Was the information passed through another staff member? Did all the relevant information get to the GP who signed the prescription? Did staff or the GP have to interrupt what they were doing to attend to other matters?
Seven – Trade offs	The use of trade-offs is ubiquitous in complex systems where there are competing goals. An example is the efficiency thoroughness trade-off where thoroughness is partially sacrificed for efficiency. These are used with the aim of achieving a good outcome. An example may be the prescribing of prescriptions without checking the medical record of the patient.	Due to pressure and demand do staff usually have to make trade-offs? Did the GP who signed the prescription make an efficiency thoroughness trade-off with the aim of ensuring good outcomes – ie seeing all the other patients and signing all the other prescriptions?
Eight – performance variability	In complex systems with changing conditions workers have to continually vary their performance and use workarounds to create successful outcomes. A simple example is staff contacting patients' relatives in order to communicate a result or a required action.	In what way do conditions in the surgery cause the staff and GPs to vary how they work? What happened in this case? Was this a normal performance variation? How did pressure, demand, constraints and resources lead staff and GPs to vary performance in this case?
Nine – emergence	Success and safety are emergent properties of systems and cannot be understood by breaking systems down into their component parts. The performance of the system may not be improved by maximising the performance of one small part of the system.	Working backwards from the event to find the first person who violated from protocol will not increase learning about the system. The interactions in the system need to be explored and understood to maximise learning and increase the chance of successful improvements.
Ten – equivalence	Success and failure come from the same source – ordinary work. Workarounds and tradeoffs are used all the time to achieve success only occasionally do they lead to poor results. To improve system	The trade-offs and performance variability described above usually lead to successful outcomes. It is important to explore and understand these so that work-as-

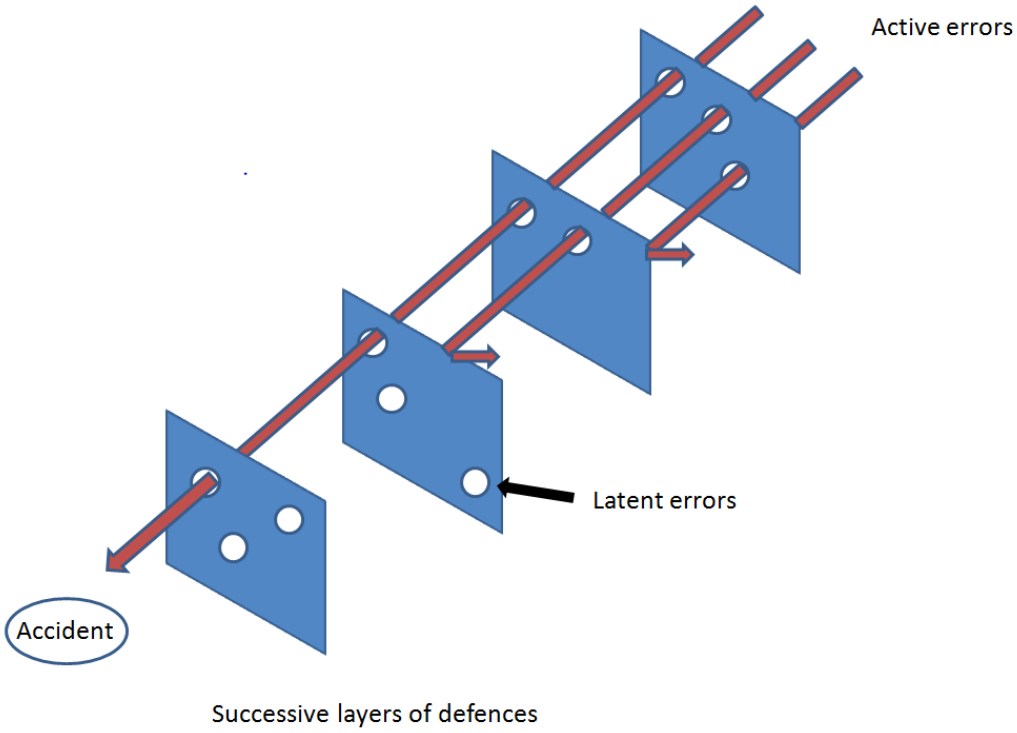
	functioning it is necessary to understand how work is done and the condition that require frontline staff to vary their performance.	done is understood. Work-as-imagined (and enshrined in protocols) may need to be altered to improve functioning of the overall system.

Figure 1 – Heinrich's Domino Model



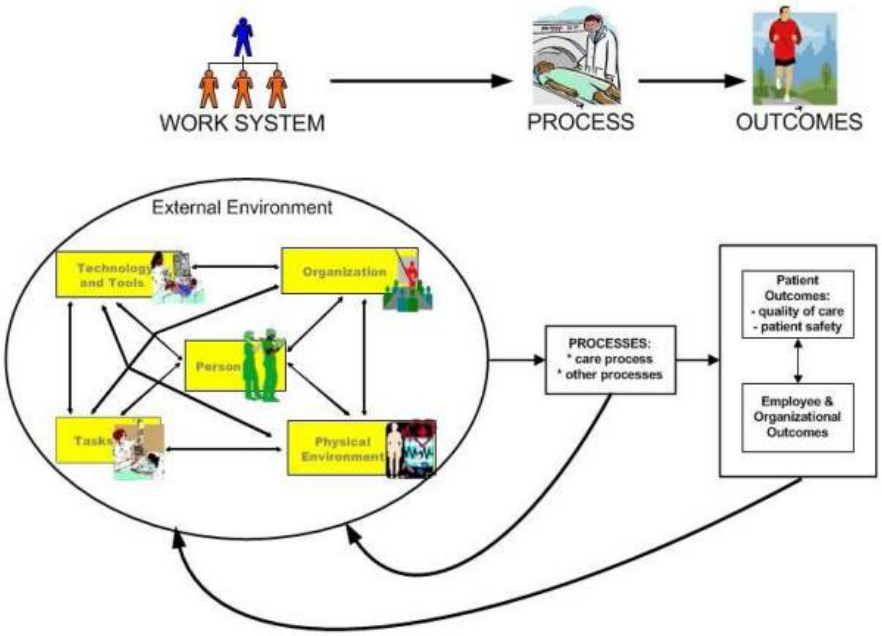
Heinrich, H.W., Industrial Accident Prevention. A Scientific Approach. Industrial Accident Prevention. A Scientific Approach. 1941(Second Edition).

Figure 2 – Reason's epidemiological model ('Swiss – Cheese' model)



Reason J. Managing the risks of organizational accidents. Aldershot: Ashgate Publishing, 1997

Figure 3 - SEIPS 2.0 model



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