Case Report

Cognitive Autopsy of a Fatal Diagnostic Error

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ABSTRACT

Background: Diagnostic error is a significant cause of preventable harm worldwide and diagnostic errors have been identified as a high priority patient safety problem by the World Health Organization. Research shows that diagnostic error occurs mainly due to system failures and 'cognitive errors' – that is, failure to synthesise all the available information. There is a worldwide consensus that medical schools and postgraduate training programmes rarely teach the diagnostic process and related decision making (clinical reasoning) in a way that is explicit, systematic and consistent with what is known from research.

Materials and methods: This paper presents a short case report and analyses it from a clinical reasoning perspective – performing a 'cognitive autopsy' of a fatal diagnostic error.

Results: Clinicians make cognitive shortcuts through pattern recognition and this is highly accurate most of the time. However, shortcuts sometimes go wrong and these are termed 'cognitive biases'. Cognitive biases are subconscious errors of judgement or perception and common examples include 'anchoring', 'the framing effect', 'search satisficing 'and' confirmation biases. These errors are more likely when clinicians are fatigued or cognitively overloaded, and when systems are not designed to mitigate human errors.

Conclusions: There is a vast literature on clinical reasoning, 'human factors', and reflection during decision making that show us how we can reduce diagnostic error in our everyday practice. This paper attempts to highlight some of the key findings in the literature that will hopefully encourage readers to explore the patient safety and clinical reasoning literature for themselves and work together to improve outcomes for patients.

INTRODUCTION

It has been estimated that diagnosis is wrong 10-15% of the time[1-3]. Post-mortem studies consistently find undiagnosed disease as the cause of death in 10-20% of patients, of which half could have been successfully treated[4]. In the United States, at least 5 percent of adults seeking outpatient care experience a diagnostic error. These errors contribute to nearly 10 percent of deaths annually and up to 17 percent of adverse hospital events[5]. Diagnostic error is more likely to result in death or serious disability than other types of errors e.g. medication or surgical-related errors[6] and diagnostic errors have been identified as a high priority patient safety problem by the World Health Organization[7]. In summary, diagnostic error is a significant cause of preventable harm and most errors go unrecognised and unreported.

In recognition of this, the USA's Institute of Medicine published its report, 'Improving Diagnosis in Health Care' and found that: 'Inaccurate or delayed diagnoses persist

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throughout all settings of care and continue to harm an unacceptable number of patients … improving the diagnostic process is not only possible, but also represents a moral, professional and public health imperative'[8]. The report concluded that while most people will experience at least one diagnostic error in their lifetime, stakeholders in quality measurement and patient safety have largely neglected the issue. As well as addressing system failures, the report emphasised the importance of listening to patients and carers, and recommended that educators should ensure that clinical curricula and training programmes should explicitly address performance in the diagnostic process and employ educational approaches that are aligned with evidence.

Diagnosis education' is an emerging field that has origins in the clinical reasoning, cognitive psychology, diagnostic error and health systems literature[9]. While medical schools and postgraduate training programmes teach a vast amount of knowledge and skills, there is a worldwide consensus that they rarely teach *the diagnostic process* and related decision making in a way that is explicit, systematic and consistent with what is known[10,11]. This is a problem, given its importance in clinical practice.

In 2005, Graber and colleagues published a study on diagnostic error in internal medicine[12] in order to try to understand the nature of diagnostic error and its root causes. One hundred cases of diagnostic error were identified across five tertiary hospitals in the USA over a 5-year period using post-mortem discrepancies, quality assurance activities and voluntary reports. Medical records were analysed to identify the root causes of diagnostic error and its impact in each case. The researchers identified no fault errors, system related errors and cognitive errors during their analysis (see table 1). Overall, they found an average of 5.9 factors per case contributing to diagnostic error. System-related factors contributed to the error in 65% of the cases but cognitive factors contributed to 74%. The most common category of cognitive error was 'faulty synthesis', or flawed processing of the available information (264 instances), followed by faulty data gathering in 45 instances; but inadequate or faulty knowledge or skills were identified in only 11 instances. This was the first study to suggest that, in addition to system related errors, diagnostic errors reflected mainly a problem with *cognitive processing*.

Table 1: Graber, Franklin and Gordon's taxonomy of diagnostic error (2005)

No fault errors	Masked or unusual presentation of disease Patient-related error (uncooperative, unable to give history)
System-related errors	Technical failure and equipment problems Organisational flaws
Cognitive errors	Faulty synthesis (information processing) Faulty data gathering Faulty knowledge

The authors concluded, 'Our study suggests that internists generally have sufficient medical knowledge and that errors of clinical reasoning overwhelmingly reflect inappropriate cognitive processing and/or poor skills in monitoring one's own cognitive processes (metacognition).'

Since the publication of this study, a debate has ensued in the medical education literature as to whether cognitive errors are simply a reflection of inadequate knowledge and experience or a problem with thinking itself[13,14]. Zwaan et al[15] analysed diagnostic errors and found that most derived from 'mistakes' rooted in inadequate knowledge. However, in terms of the aetiology of diagnostic errors, several studies have found that knowledge deficits are not nearly as significant as some might think. Most diagnostic errors involve conditions that are common and about which

doctors have considerable knowledge and familiarity – in primary care, general medicine, emergency medicine, hospital in-patients and intensive care units[16].

Literally hundreds of studies in cognitive psychology over several decades have firmly established that people's responses deviate from optimal on many reasoning tasks, and typical performance in many problems bears no correlation with intelligence or cognitive ability. Instead, the greatest variation in individual differences in optimal judgement and decision making is explained by the extent to which people engage their reflective mind – in other words, they seek information, look for evidence, analyse, weigh things up, have an awareness of context and think about their own thinking[17]. Many psychologists believe these are skills that can be taught[18]. There is also a vast literature on 'human factors' – the science of the limitations of human performance. Errors are more likely when people operate in an environment in which systems and processes are not designed to mitigate errors[19].

In this paper, we present a case report of a fatal diagnostic error and perform a 'cognitive autopsy', focussing on faulty synthesis, flawed processing of the available information, or faulty data gathering. While system-related errors nearly always play a role in serious serious diagnostic errors, the purpose of this paper is to shine a spotlight on cognitive errors and diagnosis education. The point of investigations of human error is not to find where people went wrong, but to understand why their assessments and actions made sense at the time so that systems and diagnosis education can be improved for everyone[20].

CASE REPORT

A 36-year-old woman with newly diagnosed with HIV was admitted to a medical ward at a district hospital complaining of fever, malaise and dark urine. She had previously been treated with antimalarial drugs (oral 20mg artemether/120mg lumefantrine) during a recent hospital admission. On examination, she was found to have pallor and microscopic haematuria (2+ blood on urinalysis), which was a new finding. A blood film revealed 6000 plasmodium falciparum parasites/μL. A full blood count revealed a haemoglobin of 9.2 g/dL, white cell count 6.7 x 10^9/L and platelet count 196 x 10^9/L. A diagnosis of severe malaria and schistosomiasis (bilharzia) was made. The patient was commenced on praziquantel tablets for bilharzia and intravenous artesunate for malaria. The patient's next of kin was doubtful of the diagnosis of bilharzia as the local area does not have rivers and the patient had not visited areas where she may have acquired this infection.

After commencing treatment, the patient did not show any signs of clinical improvement and her anaemia rapidly worsened. She stopped passing urine, but this was not noticed for 3 days when her relatives alerted clinical staff. Renal function tests were performed and her urea and creatinine were found to be elevated. She was transferred to Kitwe Teaching Hospital (KTH) on day 6, a regional facility with a dialysis service.

On admission to KTH her vital signs were as follows: respiratory rate 20 per minute, temperature 35.9°C, blood pressure 120/75 mmHg, heart rate 110 per minute and Glasgow Coma Score 14. Admission laboratory tests revealed a urea of 28 mmol/L and creatinine 1,145 μmol/L with a haemoglobin of 4.5 g/dL. Plasma electrolyte levels were not analysed due to a lack of chemical reagents. Hemodialysis was commenced with a simultaneous blood transfusion. Unfortunately, the patient collapsed 3 hours after dialysis was completed and died.

DISCUSSION

Clinical reasoning can be conceptualised as a process with different components that each require specific knowledge, skills and behaviours. The components are: history and physical examination, use and interpretation of diagnostic tests, problem identification and management, and shared decision making[21].

Undoubtedly, system factors played a role in this case. Several studies conducted in the UK and elsewhere have demonstrated a failure of systems to recognise and effectively intervene when patients in hospital deteriorate. The main causes of suboptimal care are failure of systems as well as lack of knowledge, failure to appreciate the clinical urgency, lack of supervision and failure to seek advice[22]. As a result, early warning scores (aggregate scores of patient's vital signs) are now widespread in many countries[2]. These oblige staff to perform regular measurements of vital signs and alert doctors when vital signs become abnormal (e.g. anuria). Several studies have shown that early intervention in patients who deteriorate improve outcomes[24].

However, there was also a failure to synthesise the available data from the patient's history and physical examination: the finding of microscopic haematuria led to a diagnosis of schistosomiasis instead of blackwater fever; the latter is a diagnosis that requires close monitoring for signs of deterioration (see table 2).

Table 2: Bedside classification of severe malaria in adults[25]

Group 1 (parenteral antimalarials and supportive therapy required)	Prostrated or obtunded adults Respiratory distress (acidotic breathing) Shock (systolic blood pressure <80 mmHg) Anuria Significant GI bleeding
Group 2 (can be treated with oral antimalarials but close monitoring is required because of risk of deterioration)	Haemoglobin < 7g/dL Seizures Haemoglobinuria (blackwater) Jaundice

Clinicians make cognitive shortcuts through pattern recognition and this is highly accurate most of the time[26]. However, shortcuts sometimes go wrong and these are termed 'cognitive biases'. Cognitive biases are subconscious errors of judgement or perception and common examples include 'anchoring', 'the framing effect', 'search satisficing' and 'confirmation bias'[27]. These errors are more likely when clinicians are fatigued or cognitively overloaded. The patient had falciparum malaria and the clinical probability of bilharzia was low. Therefore, the presence of microscopic haematuria should have (with hindsight bias) been interpreted differently in this context.

Studies show that formal and experiential knowledge of medicine is key for diagnostic accuracy, but even experienced doctors make mistakes. However, one cognitive intervention is effective: several studies show the benefits of reflection during decision making on diagnostic performance[28]. In studies of medical students and residents, when they are instructed to reflect while solving cases, their diagnostic performance is significantly better. This can be simple as asking, 'What's the evidence for this? What else can it be?' Reflection is thought to work because it mobilises knowledge or generates questions relevant to a case. Its impact is greatest when the case is complex[14]. Other educational interventions also have strong evidence. In studies of medical students with similar knowledge levels, high performers organise their knowledge in a qualitatively different way to low performers[29] – they organise their knowledge in way designed to manage patient problems. Knowledge organisation as opposed to generic knowledge has been found to be key to effective clinical reasoning ability[30,31]. In addition, the ability to encapsulate a patient's problem using precise medical language *before* thinking through potential differentials is an important skill that helps to organise and retrieve knowledge from long term memory relevant to the case, and is associated with 80% accurate resolution of a complex problem, as opposed to near zero resolution when this is not done[32].

In many countries there are moves to improve the teaching of clinical reasoning, as well as make healthcare systems safer. Many clinicians have not heard about cognitive errors and have not been educated about human thinking and decision making, despite its importance in clinical

practice. Medicine has a lot to learn from other domains including aviation and cognitive psychology. We hope this short report will encourage readers to explore the patient safety and clinical reasoning literature for themselves and work together to improve diagnosis education in Zambia and beyond.

CONSENT

Consent has been obtained from the patient's next of kin to publish this report.

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