



## Review

## The role of non-technical skills in surgery

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## HIGHLIGHTS

- The volume of surgical procedures is increasing.
- Technical skills have come under increased scrutiny, alongside a realisation of the importance of non-technical skills.
- Non-technical skills include situational awareness, decision making, communication, teamwork and leadership.
- Further research is required to demonstrate the mechanism linking impaired non-technical skills and patient harm.

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## ABSTRACT

Non-technical skills are of increasing importance in surgery and surgical training. A traditional focus on technical skills acquisition and competence is no longer enough for the delivery of a modern, safe surgical practice. This review discusses the importance of non-technical skills and the values that underpin successful modern surgical practice.

This narrative review used a number of sources including written and online, there was no specific search strategy of defined databases. Modern surgical practice requires; technical and non-technical skills, evidence-based practice, an emphasis on lifelong learning, monitoring of outcomes and a supportive institutional and health service framework. Finally these requirements need to be combined with a number of personal and professional values including integrity, professionalism and compassionate, patient-centred care.

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## 1. Introduction

Globally an estimated 234 million major surgical operations occur annually [1]. This volume of procedures is thought to result in seven million complications and one million deaths - double the number of annual maternal deaths [1]. Modern surgery now includes; transplantation, joint replacement, free tissue transfer and advanced multidisciplinary trauma management, as well as minimally-invasive, endoscopic, laparoscopic, robotic and microsurgical techniques.

So what is the key to delivering safe, high quality and reliable surgical practice? In this article, we discuss the importance of technical skills, non-technical skills, evidence-based medicine, monitoring outcomes, the wider hospital culture context for surgical practice and the professionalism and values that underpin successful surgical practice.

## 2. The importance of technical skills

It is clear since the very first recorded surgical operation in India circa 600BC by Sushruta [2], that technical skills are important. A technical skill refers to any psychomotor action or related mental faculty acquired through practice and learning pertaining to a particular craft or profession [3]. Much has been written about the importance of developing good hand-eye co-ordination, manual dexterity and focused psychomotor skills in a 'craft' specialty like surgery [4]. The focus on technical skills development has led to the creation of standard assessments for technical skills, such as the Objective Structured Assessment of Technical Skills (OSATS) [5].

### 2.1. A lesson from history – laparoscopic cholecystectomy

History has shown that the importance of good technical skills should not be underestimated. A powerful example from history is laparoscopic cholecystectomy. The first reported laparoscopic cholecystectomy was done by Phillippe Mouret in France in 1987 [6]. Within five years it was established as a feasible alternative to the open approach [7]. However, doubts were soon raised about its safety and the technical skills credentials of those performing them [8,9]. Professional societies began to emphasize training both inside and outside the operating room (OR) and stipulated minimum requirements for those performing laparoscopic surgery [10]. Skills courses were introduced to teach basic psychomotor skills and to get surgeons accustomed to the fulcrum effect, viewing two-dimensional images on a screen two meters away and limited tactile feedback.

Gradually laparoscopic cholecystectomy became safer and a viable alternative to the open technique. Residents today can gain significant skills and experience in simulated environments, prior to performing the procedure on patients in the OR. Examples include virtual laparoscopic simulators, cadaveric porcine models and even simulated procedures using anaesthetised pigs [11]. This is in addition to observing and assisting senior surgeons during clinical training. Today laparoscopic surgery is considered 'safe' and is more widely used than the open technique [12]. The debate has now moved onto the number of ports one should use [13].

### 2.2. Rising scrutiny of surgical technical skills

Technical skills performance in surgery has come under increased scrutiny in recent years, with several highly publicized cases linking poor outcomes with skill deficiency [14–16]. Concerns over technical skills are often acted on swiftly. For example, excess mortality and concerns voiced by staff at the Pediatric Cardiac Surgery Unit at the Bristol Royal Infirmary in the UK resulted in a public inquiry [17]. In addition, three surgeons were found guilty of serious professional misconduct by the UK's General Medical Council (GMC) in connection with the deaths of 29 babies between 1988 and 1995 [18]. More recently, similar concerns raised about pediatric cardiac surgery at another UK hospital (Oxford Radcliffe Hospital) led to its closure in 2010 [19]. In this case low case volumes were blamed in part for the poor outcomes with the Oxford Radcliffe unit being the smallest in the region and doing half as many cases as the next smallest unit.

These are just two illustrative examples to demonstrate the consequences of the now evidence-based and deeply held belief of the importance of technical skills for safe surgery. We know that technical skills tend to improve with experience and this is evidenced by the volume–outcome relationship in much of surgery, especially complex operations like abdominal aortic aneurysm repair [20] and colorectal cancer surgery [21].

## 3. Is technical competence enough for modern safe surgical practice?

The preceding section makes it clear that technical skills are important for successful surgical practice. Here, however, we argue that they are not enough in isolation.

In 1999, the Institute of Medicine published the report *To Err is Human* [22] and stated that between 44,000–98,000 people die in US hospitals each year from medical errors that could have been prevented. This was followed in the UK by the Chief Medical Officer's report "An organisation with a memory" [23], which summarized a very similar problem in the UK. A retrospective patient record review study by Vincent and his colleagues found that adverse events in which harm is caused occur in 10% of hospital admissions in the UK, or >850,000 a year [24]. This costs the UK's National Health Service (NHS) an estimated £2bn a year in additional hospital stays alone and £400m a year settling clinical negligence claims, without considering the wider human, economic and societal costs. Publications such as these sparked a worldwide interest in patient safety research and interventions.

In surgery, there is increasing evidence that such harm is not due to deficient technical skills alone. The 2010 Scottish Audit of Surgical Mortality found that technical errors during the surgery itself constituted just 4.3% of the operative areas of concern identified, with far more errors stemming from poor decision-making [25]. Further, numerous studies have shown that deficiencies in teamwork in the OR, are significant contributors to adverse events and patient harm reaching surgical patients [26–29]. Taken together, this evidence has led to an increasing focus on non-technical skills, systemic issues and values for the surgical profession.

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