

# Reducing perioperative harm in New Zealand: the WHO Surgical Safety Checklist, briefings and debriefings, and venous thromboembolism prophylaxis

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## ABSTRACT

New Zealand appears to have a relatively high rate of perioperative adverse events. The Health Quality & Safety Commission's Safe Surgery NZ programme was introduced to address the rates of perioperative harm in New Zealand by promoting proper and effective use of the World Health Organization (WHO) Surgical Safety Checklist, and by encouraging use of operating room (OR) team briefings and debriefings. Venous thromboembolism prophylaxis is a key part of the checklist as deployed in New Zealand ORs, but it remains underused or variably used as well. Communication and teamwork are critical to improving patient safety and efficiency in the OR, and these interventions have demonstrated effectiveness in building and melding effective teams.

## Perioperative harm in New Zealand

Since inception, the New Zealand Health Quality & Safety Commission (the Commission) has been particularly interested in the reduction of perioperative harm in our operating rooms (ORs). New Zealand appears to have a relatively high rate of perioperative adverse events. OECD data from 2012/13 suggested New Zealand had one of the highest documented rates of postoperative sepsis (1,260 per 100,000 hospital discharges in 2012/2013), the third highest rate of foreign bodies left in during a procedure (10.8 per 100,000 discharges), and was six countries behind the average for pulmonary embolism and deep vein thrombosis (PE and DVT), with a crude rate of 912 per 100,000 discharges. Only four OECD countries reported worse rates.<sup>1</sup>

Some argue that we are simply better at recording adverse outcomes, but regardless, these numbers are unacceptable. The Commission's Safe Surgery NZ programme was set up specifically to improve this

situation through promulgation of several evidence-based interventions, including the World Health Organization (WHO) Surgical Safety Checklist, surgical team briefings and debriefings, and effective venous thromboembolism prophylaxis. These formed the backbone of the recent focus on reducing perioperative harm in the *Open for Better Care* campaign. This article provides background and context to this work, and a discussion of the evolution of perioperative care in New Zealand.

## WHO Surgical Safety Checklist

The WHO Surgical Safety Checklist (the Checklist) is an evidence-based 19-item tool designed to improve patient outcomes by reducing error and improving teamwork and communication in the OR. The World Alliance for Patient Safety, recognising the unacceptably high rate of perioperative morbidity and mortality, identified ten universal objectives for safe surgery (see Figure 1) through consultative work in its second global challenge,

**Figure 1:** World Alliance for Patient Safety's Ten Objectives for Safe Surgery

Objective 1.	The team will operate on the correct patient at the correct site.
Objective 2.	The team will use methods known to prevent harm from anaesthetic administration, while protecting the patient from pain.
Objective 3.	The team will recognize and effectively prepare for life-threatening loss of airway or respiratory function.
Objective 4.	The team will recognise and effectively prepare for risk of high blood loss.
Objective 5.	The team will avoid inducing an allergic or adverse drug reaction known to be a significant risk to the patient.
Objective 6.	The team will consistently use methods known to minimize risk of surgical site infection.
Objective 7.	The team will prevent inadvertent retention of sponges or instruments in surgical wounds.
Objective 8.	The team will secure and accurately identify all surgical specimens.
Objective 9.	The team will effectively communicate and exchange critical patient information for the safe conduct of the operation.
Objective 10.	Hospitals and public health systems will establish routine surveillance of surgical capacity, volume and results.

the 'Safe Surgery Saves Lives' initiative.<sup>2</sup> These objectives were underpinned by an appreciation of the importance of teamwork in achieving good outcomes for patients undergoing surgery.

The success of checklists in high-reliability organisations such as aviation, the military, and nuclear power, as well as in central line infections,<sup>3,4</sup> inspired the development of this tool (see Figure 2) to help achieve these objectives. From the outset, the Checklist was designed to improve teamwork, communication and culture in addition to facilitating certain important checks,<sup>5,6</sup> and there is increasing evidence that its effective use can achieve all of these things.<sup>7-10</sup>

The University of Auckland and Auckland City Hospital collaborated as one of the eight international sites in the initial evaluation of the Checklist; introducing the Checklist was associated with substantial reductions in perioperative mortality (from 1.5% to 0.8%), and complications (from 11% to 7%).<sup>11</sup>

Numerous studies have supplemented these initial findings,<sup>6,10,12-14</sup> and results have been integrated into two systematic reviews.<sup>15,16</sup> Some extended the scope of the intervention, but collectively they provide considerable support for training, briefings (see below), and other initiatives aligned with the Checklist in promoting

teamwork, communication, and safety. The Netherlands' Surgical Patient Safety System (SURPASS), for example, found a significant reduction in in-hospital mortality (1.5% to 0.8%) and in overall complications (27.3 to 16.7 per 100) after implementation of a comprehensive surgical checklist.<sup>17</sup> More recently, a stepped-wedge cluster randomised controlled trial showed a reduction in complications from 19.9% to 11.5% with the use of the Checklist, giving an absolute risk reduction of 8.4. Length of stay decreased by 0.8 days, and mortality was significantly decreased in one of the two study centres, but not the other.<sup>18</sup> Semel et al found its use reduced cost as well as harm,<sup>19</sup> and a New Zealand analysis has suggested it will provide an annual steady state benefit of NZD 5.7 million to our health system, primarily through avoided complications of surgical care.<sup>20</sup>

The introduction of the Checklist has not come without its challenges. Effective implementation requires the buy-in of all members of the OR team. This depends on leadership, and on an understanding of the Checklist's wider objectives.<sup>21</sup> Improvement requires concerted effort over time. In a large Veterans Health Administration (VHA) controlled study, training of medical teams in briefings, debriefings and the Checklist (amongst other things) was associated with a steady decrease in mortality over

Figure 2: Surgical Safety Checklist (Australia and New Zealand)

# Surgical safety checklist

## 1 Sign in

**Confirm surgeon available**  
**Before induction of anaesthesia, confirm with patient:**

- Identity
- Site and side
- Procedure
- Consent

**Site marked or not applicable**

**Does the patient have:**

**Known allergies?**

**Difficult airway or aspiration risk?**  
If yes, is equipment/assistance available?

**Risk of >500 ml blood loss recorded (7 ml/kg in children)?**  
If yes, are adequate intravenous access and fluids planned?

**Anaesthesia safety checklist completed**

**Check and confirm prosthesis/special equipment to be used**

## 2 Time out

**Before an incision, confirm all team members have introduced themselves by name and role**

**Surgeon, anaesthetist, and nurse verbally confirm:**

- Patient
- Site and side
- Procedure
- Consent
- Any known allergies

**Anticipated critical events**

**Surgeon reviews:**  
Critical or unexpected steps, operative duration, anticipated blood loss?

**Anaesthesia team reviews:**  
Patient specific concerns?  
Has the ASA score been recorded?

**Nursing team reviews:**  
Has sterility (including indicator results) been confirmed?  
Are there equipment issues or concerns?

**Has antibiotic prophylaxis been given within the last 60 minutes?**

**Has the plan for VTE prophylaxis during the operation been carried out?**

**Is essential imaging displayed?**

## 3 Sign out

**Verbally confirm with the team after final count:**

- The name of the procedure recorded
- That instrument, needle, sponge and other counts are correct
- How the specimen is labelled (including patient name)

- The plan for ongoing VTE prophylaxis
- Whether there are any equipment problems to be addressed
- Postoperative concerns/plan for recovery and management of this patient

**Box 1:** An implementation case study: Ontario

The Canadian government mandated 'compliance' with use of the Surgical Safety Checklist as a compulsory patient safety indicator to be reported on biannually by Ontario hospitals in 2010.<sup>23</sup> A March 2014 study of 101 Ontario hospitals failed to show statistically significant improvement in mortality or complications three months after the Checklist's introduction.<sup>24</sup> Adjusted risk of death was 0.71% (95% confidence interval: 0.66 to 0.76) before and 0.65% (0.60 to 0.70) after implementation of the Checklist ( $p=0.07$ ).

On the day of the study's publication, Canada's largest circulated national newspaper wrote, "a large new Canadian study is calling the checklist orthodoxy into question."<sup>25</sup> However, many of the procedures were elective, with low baseline mortality, and the study may have been underpowered. More importantly, three months is simply too early to expect any substantial shift in practice, particularly in the absence of a thorough implementation initiative.

In response to the Ontario findings, Haynes et al noted, "Government-mandated adoption often results in high rates of reported compliance without true behavior change."<sup>26</sup> Two recent papers from the UK and Spain also support a similar discrepancy between reported compliance and 'meaningful compliance'—that is, between 'ticking boxes' and using the Checklist effectively—arising from centrally mandated use without work to promote the buy-in of clinicians.<sup>27,28</sup> The authors of the Ontario study acknowledged the challenges associated with mandated use.<sup>24</sup> In an accompanying editorial, Lucien Leape suggested, "The likely reason for the failure of the surgical checklist [was] that it was not actually used."<sup>29</sup> The study did not measure compliance, which is akin to a drug trial with no measure of how many participants actually took the drug.

The findings of this study add an important contribution to our understanding of the role of the Checklist. It is, and always has been, just a new tool to facilitate process improvement. Tools only work if used and, indeed, used well.

the duration of the study (to an overall reduction in annual mortality of 18% compared with 7% in the control group).<sup>22</sup> There needs to be a sustained shift in teamwork, communication and attitude to safety, which does not happen instantly (see Box 1).

## A New Zealand perspective

The WHO Surgical Safety Checklist is used in the majority of surgical cases in New Zealand, in every government hospital and in the vast majority of private facilities. However, although 'adoption' of the Checklist is widespread, a recent survey has shown that use is not consistent, and that there is considerable variability in participation across professional groups.<sup>30</sup> This is likely to undermine the Checklist's potential benefits and there is ongoing effort to evaluate barriers to compliance with administration of the Checklist and to engagement of OR teams in the process, and to identify ways in these barriers can be broken down.

Since participation in the original WHO Checklist study,<sup>11</sup> the University of Auckland Group has maintained a long-term focus on studying these matters. Utilising direct observations by trained collaborators, they

have demonstrated variable compliance with administration of the three Checklist domains (Sign In, Time Out, Sign Out) and the associated Checklist items in a milieu where all Checklist domains are initiated and led by the circulating nurse from a paper copy of the Checklist. For example, an audit published in 2011<sup>31</sup> quantified compliance in the Auckland District Health Board (DHB) OR suite that participated in the original WHO study. Several years after completion of the study, there was good compliance with administration of the Sign In and Time Out domains (99% and 94% respectively), but the Sign Out domain was administered on only 2% of occasions. There was substantial variation in compliance with administration of the individual Checklist items, with some being articulated in 100% of cases, while others were used on as few as 27% of occasions. A second audit in the same operating suite some two years later reported little change in these compliance data, although the Sign Out domain had improved to 22% of occasions.<sup>32</sup>

Another concerning outcome of both studies was the finding that engagement of the OR teams (surgeons, nurses, and anaesthetists) in the process was poor, even when a liberal definition of 'team engagement' was used; at least one member of the team

must have ceased all activity apart from attending to the Checklist for the team to be considered engaged. For example, during Time Out when all three teams were invariably present, engagement of all teams was only seen on 14% of occasions.<sup>32</sup> Similarly, during Sign In, when the nursing and anaesthesia teams were invariably present (and surgeons almost always absent), engagement of both teams present was only seen on 39% of occasions. It was also telling that in 300 Checklist domains observed there was not one instance where all staff (every member of every team) in the OR were properly engaged in Checklist administration.

Considerable thought has been given to identifying the reasons for the various problems identified in the above studies.

Omission of Sign Out appeared attributable to the fact that it was not as clearly linked to an identifiable OR event as the other two Checklist domains. There was thus no naturally occurring aide-mémoire to signal that Sign Out should be initiated.<sup>31</sup>

Selectivity in Checklist item administration appeared attributable to value judgments by administering staff as to which items were most important, or to perceptions that some questions might elicit a petulant response. For example, during Sign In, Checklist items with obvious face validity (those related to patient identity and the nature of the surgical procedure) were administered in 100% of cases. In contrast, checks on whether an airway problem was anticipated, or whether the surgeon was available, were administered in approximately 25% of cases.<sup>31</sup> One item (the question about the anaesthetic machine check) typically elicited an irritable response and was the least-often administered (20% of cases). The latter illustrates the potential for negativity where the Checklist queries practices that a team might consider are 'culturally engrained' or immutably embedded in their practice.

Poor team engagement appeared primarily attributable to distractions by other concurrent tasks. For example, anaesthetists were prone to continuing with tasks like intravenous line insertion while the nurse administered Sign In, and surgeons were prone to continue to arrange

the operating field while the nurse administered Time Out. Such disengagement by senior clinicians proved demotivating to the nurses, and there was a tendency for the Checklist administration to be truncated, but for tick-boxes to be checked anyway to indicate compliance.<sup>33</sup> This practice has been noted in other New Zealand surveys.<sup>34</sup>

Strategies to address all of these issues have been conceived and are in the process of being rolled out across Auckland DHB. A policy to link Sign Out to completion of the first swab and instrument count has brought clarity and consistency to the timing of this domain. After consultation with staff, all domains of the Checklist have been modified in order to remove some redundant items and to clarify the meaning of others. Most significantly, a radical change in the administration paradigm has been introduced. Paper Checklists and their associated tick boxes have been abandoned, and the Checklist now appears in all ORs as three large wall charts (one for each domain) that can be read from a distance. The anaesthetist leads the Sign In domain, and the surgeon leads the Time Out domain; the obvious logic being that placing the team most prone to disengagement in charge of administering the relevant domain is likely to ensure they remain engaged. The use of this system in the Counties Manukau DHB ORs appeared to result in better team engagement.<sup>32</sup>

Airline pilots do not tick boxes on forms when they use a checklist. The Checklist was never intended to be used to record compliance with key processes—it was intended to improve compliance with these processes. Changing to a shared leadership paradigm and abandoning the ticking of boxes should make that explicit. The impact of these changes on compliance and engagement in the first Auckland DHB OR suite to roll them out is being audited, and it is hoped that the Auckland DHB experience may inform decisions regarding Checklist practice being considered by other DHBs across the country. These changes have been applauded and endorsed by the Commission, which has taken steps to ensure that they are reflected positively in the relevant national Quality and Safety Marker.<sup>35</sup>



## Briefings and debriefings for surgical teams

In the 1970s, investigators discovered that human error accounted for 70% of all crashes in aviation, and that the majority of these “consisted of failures in leadership, team coordination and decision-making.”<sup>36</sup> Communication failures are also the primary source of human error in the OR: in the US, the Joint Commission for Accreditation of Healthcare Organizations (JCAHO) reports communication as the root cause in more than 75% of operative and postoperative sentinel events.<sup>37,38</sup> Team briefings and debriefings have been used routinely in air forces and the aviation industry for decades, and more recently as part of NASA's Crew Resource Management (CRM), to combat these difficulties in communication in the cockpit. The introduction of briefings and debriefings to the OR has been more recent, but their value is becoming increasingly clear.

Einav and colleagues found surgical briefings reduced the number of nonroutine events per operation by 25% (from 2.1 to 1.6 events) and increased the number in which no nonroutine event was observed at all.<sup>39</sup> Lingard et al reported a decrease in communication failures in the OR (late, inaccurate, unresolved, or exclusive communications) from 3.95 per procedure before introduction of briefings to 1.31 after.<sup>40</sup>

A 2012 study in a large medical centre in Michigan found that “briefings and debriefings were a practical and effective strategy to surface potential surgical defects.”<sup>41</sup> Using the Safety Attitudes Questionnaire, Makary and colleagues found briefings accounted for a reduction in OR staff's perception of risk for wrong-site surgery, and improved perceived collaboration.<sup>42</sup>

Teams also report improvements in efficiency with briefings and debriefings, in contrast to some perceptions to the contrary.<sup>43</sup> For example, a Johns Hopkins study found preoperative briefings were associated with a 19% reduction in communication breakdowns in the OR, a 31% reduction in unexpected delays, and an

82% reduction in surgeon-reported unexpected delays.<sup>44</sup>

In the UK, use of both checklist and briefing CRM techniques reduced list time to the point one orthopaedic surgeon commented he had increased his list from four to five hip replacements.<sup>45</sup>

### Briefings

Briefings are used to share important information between different team members and groups to orient them around the tasks ahead, and to anticipate potential unexpected events or deviations from normal practice. Einav and colleagues observe, “Surgical teams... are frequently not familiar with all of the available data and may be only partially informed about the surgical plan.”<sup>39</sup> Briefings are a simple, short verbal interchange involving the whole operating team prior to commencement of a list, designed to ensure the team members have shared mental models and interpretations of plans, priorities, and potential hazards to patients. Their readiness and cohesion as a team is thereby increased.<sup>46</sup>

Figure 3 below shows a recommended structure for briefings, which can be tailored to individual local practice and context.

### Debriefings

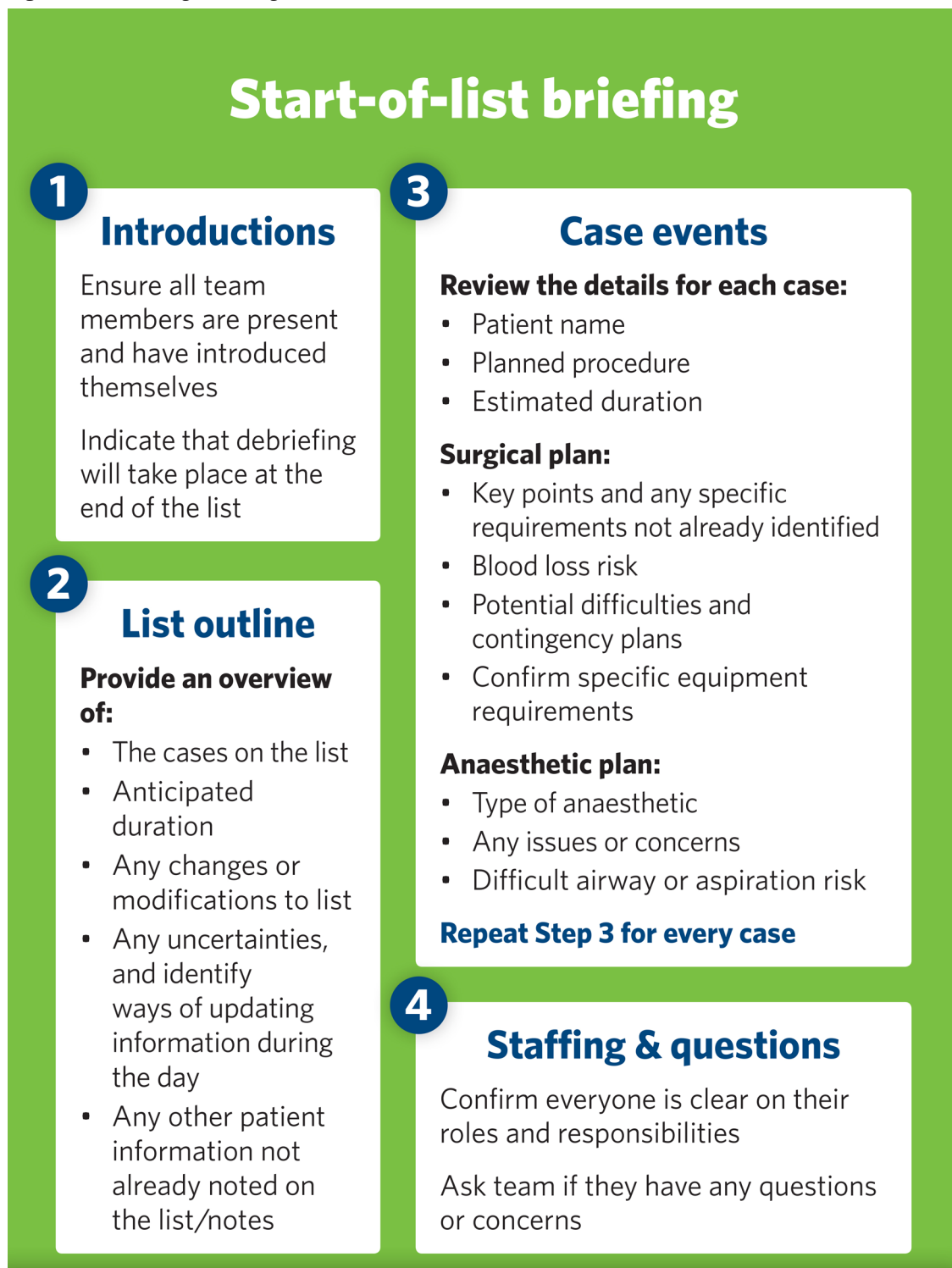
Debriefings, used by flight crews since World War Two, are a form of post-action review. They are “the systematic process of sharing observations and interpretations of team processes and performance” after the operation—be it military or surgical—is complete.<sup>47</sup> Debriefings enable teams to take the time to reflect and learn as a group from a real-time situation. After a list is complete, a team shares what went well and what didn't go to plan, what can be learnt and what can be improved, and provide a forum to say thank you—or simply, ‘well done.’

Figure 4 shows a recommended structure for debriefings, which can be tailored to individual local practice and context.

## Complexity, autonomy and teamwork

Briefings and debriefings complement the use of the Checklist, and as explained

Figure 3: Structuring a briefing.



**Figure 4:** Structuring a debriefing



**Box 2:** Kinds of situations and perioperative examples (adapted from running text in Gawande A. *The Checklist Manifesto*)

	Example	Perioperative examples
<b>Simple</b>	Baking a cake from a mix—there is a recipe	Anaesthetic machine check; ensuring there are sufficient units in the blood bank for a foreseeable complication
<b>Complicated</b>	Sending someone to the moon—iterable, steps can be established, a series of problems surmounted, but no straightforward recipe exists	Removal of an adrenal gland containing a pheochromocytoma
<b>Complex</b>	Organic, and not iterable, like raising a child. “Expertise is valuable, but most certainly not sufficient...[and] outcomes remain highly uncertain.” <sup>50</sup>	Ensuring the team is sufficiently in sync to respond rapidly and adequately to an accidentally torn vena cava

above, several major studies have shown the benefit of more comprehensive initiatives that incorporate various aspects of improving teamwork, communication and the reliability of process into surgical practice. The value of this becomes clear if one reflects on some basic principles of human performance in complex systems.

“Human error is inevitable—particularly under stressful conditions”.<sup>48</sup> The prime objective of most checklists is to mitigate this inevitability. However, “at the heart of the WHO initiative is something much more fundamental than simply avoiding mistakes.”<sup>49</sup> Checklists are a way of bridging the simple, the complicated and the complex, of promoting uniformity in key practices, and of welding a team together around the needs of the patient before them.

In *The Checklist Manifesto*,<sup>50</sup> Gawande draws from Zimmerman and Glouberman<sup>51</sup> to describe and make clear this distinction between simple, complicated and complex situations using the example of an error during the excision of a rare kind of tumour (see Box 2).

Healthcare is, overall, a complex system. A surgical operation in itself should be a complicated process rather than a complex one. In some cases it should be a simple process and certainly there are common aspects of all surgical operations that are just a matter of process that is simple but essential. A prime objective of the Checklist is to get these simple and complicated processes right, every time.

In the example from Gawande, during Sign In the Checklist item prompted him to mention the potential for large blood

loss; this reminded the nurse to check with the blood bank; there she found that units of packed red blood cells were missing, and this problem was addressed before it occurred. This is an example of getting a simple process right.

The Checklist aims to do more than this. In fact, it isn’t strictly just a checklist, and it is certainly not designed to ‘dumb down’ surgery or anaesthesia. Instead, it is a tool that asks clinicians to think, collaborate and plan around their patients, that also includes some important items to check. The expertise of our teams is not in doubt, but there are ever-present challenges to good teamwork in the OR: traditional training; fear of speaking out; power gradients; silo thinking; unstable teams; and shifting leadership. Good teamwork and communication become increasingly important as situations move from the routine and simple or complicated into the unexpected and complex. It is when decisions have to be made quickly—without the benefit of regular practice—that lives can be saved or lost by the way in which the team works as a team. In Gawande’s example, he believes that when the emergency occurred, not just the retrieved units, but also the teamwork and intimacy generated by the process of using the Checklist contributed to effective and coordinated efforts that were successful in saving a life as the patient lost almost his entire volume of blood into his abdomen within 60 seconds.<sup>50</sup>

Willingness is all. In New Zealand, where informality is key, we have a unique opportunity to build on that informality and more rapidly tap the Checklist’s power to help us better communicate as a team

around anaesthetised patients' needs, rather than around spurious or outdated hierarchies and perceived rights to practise autonomously. Autonomy, based on authority, is outmoded healthcare today. It is reasonable for patients to expect that teams will work together to implement evidence-based medicine, and that appropriate tools will be used to improve the reliability of processes. When asked, patients support the use of the Checklist.<sup>34</sup> Good teamwork and communication avoids harm, saves lives, and improves efficiency,<sup>52-54</sup> and so do simple tools to improve processes through checking.

## Venous thromboembolism (VTE), surgical safety and the Checklist

The WHO Surgical Safety Checklist was always intended to be modifiable and tailored to the processes, methods and contexts of the countries and facilities where it is used. Ensuring that adequate VTE prophylaxis has taken place before skin incision is a core part of the Checklist as adapted for the New Zealand context, as it is for the NHS Checklist in England and Wales, and elsewhere.<sup>55,56</sup> The implications of VTE prophylaxis are different in different areas—Asia, for example, where reported rates are very low.<sup>57</sup>

Despite the evidence, and the availability of clinical practice guidelines for the last twenty years, and the clear arguments for risk assessment screening and prophylaxis, effective VTE prophylaxis remains underused or variably used in New Zealand operating theatres.

The Health Quality & Safety Commission's June 2014 Perioperative Mortality Review Committee report showed a PE-associated mortality rate in New Zealand of 8.7 per 100,000 patients who underwent an elective or waiting list procedure.<sup>58</sup> About one in ten patients experiencing a PE will die as a result of their PE.<sup>59,60</sup> That's about one death from PE in every 11,500 procedures in this country.

The risk of VTE increases tenfold in patients admitted to hospital, with contributing factors including general ill

health or comorbidities, reduced mobility, smoking, and poor fluid intake. Major surgical procedures (particularly orthopaedic and other high-risk operations) are further risk factors, but patients who had short or minor procedures have also developed fatal PE. The incidence of PE is related to age—Australian data show peak incidence of DVT and PE in the 75–79 year old age group—but those aged 55–59 still contributed more than half the numbers of the older group. New Zealand estimates are lacking, but total hospital inpatient expenditure on VTE in Australia in 2008 was estimated at AUD 81.2 million, with each case of VTE costing in excess of \$10,000.<sup>61</sup>

Recurrence of proximal DVT occurs in up to 30% of patients within ten years of a first episode of venography-confirmed DVT, as does postphlebotic syndrome.<sup>62</sup> DVT alone is still an issue, as it can lead to complication after complication.<sup>63</sup>

Often surgeons can falsely assume anaesthetists have overseen DVT prophylaxis, and conversely.<sup>64</sup>

Prevention and screening are crucial—treatment of PE is difficult, and with fatal PE, 70% of patients die within three hours of onset of symptoms.<sup>63</sup> Appropriate options for thromboprophylaxis include pharmacological methods, such as the use of anticoagulants, and mechanical measures, such as compression stockings or intermittent pneumatic compression devices (IPC). Patients are an important part of their own care, and it is important to keep them informed of more general measures such as drinking enough water, keeping active, and wearing compression stockings postoperatively. A combination of these thromboprophylactic techniques has been shown to reduce the risk of DVT and both fatal and non-fatal PE by more than 60%.<sup>65</sup> The choice of thromboprophylaxis is less important than the need to consider it in every patient and implement some reasonable strategy in those who are at risk. Therefore, the New Zealand Checklist simply asks, "Has the plan for VTE prophylaxis during the operation been carried out?" As clinicians, it is worth reflecting on the fact that this question might matter to us if and when we become patients.

## Conclusion

Effective teamwork, communication, and a high degree of reliability in process (including, notably, VTE prophylaxis) in surgical practice are crucial to reduce instances of perioperative harm. There is strong evidence that engaged and effective use of the WHO Surgical Safety Checklist can reduce patient harm, and briefings and

debriefings can add to these gains while simultaneously improving efficiency. The Health Quality & Safety Commission's Safe Surgery NZ programme is designed to ensure that the excellent outcomes sought for surgical patients in New Zealand are actually achieved. The Commission is grateful for the work undertaken by clinicians and DHBs to date.

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### Competing interests: Nil

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