Editorial

''Mock before you block'': an in-built action-check to prevent wrong-side anaesthetic nerve blocks

"Mock:. . .v. make a replica or imitation of something; adj. . .not authentic or real but without the intention to deceive" (Oxford English Dictionary)

Whereas the seriousness of wrong-site surgery is long established, the notion of wrong-side anaesthetic nerve block as an adverse event is more recent; probably published first by Edmonds et al. in 2005 [1]. As a preventive measure, they suggested a 'pre-anaesthetic check' equivalent to the pre-operative surgical 'time out' [2, 3]. Analyses of large data sets (> 10,000 patients) have estimated the incidence of wrong-site blocks to be ~ 4 in 10,000 (~0.04%; upper 95% CI ~0.1%, or ~1 in 1000) [4–6]. Wrong-site blocks can readily occur in awake patients as the patient may believe that this is the correct way to perform the procedure [4]. Since 2015, the error has been classed by NHS England as a 'Never Event', set aside for special consideration and used (albeit perhaps erroneously) as a marker of overall hospital safety and performance [7, 8]. As a focus of regulators, prevention is rightly regarded as a priority.

Contributory factors in a wrong-site block are well documented [4–6, 9] (Table 1). Hitherto, all recommendations for prevention have focused on introducing additional layers of verbal checking before conducting the block. This culminated in the Stop Before You Block initiative in 2011 [10]. A wonderfully catchy phrase, it was rapidly adopted by the Safe Anaesthesia Liaison Group (SALG), and the message disseminated across the UK and elsewhere (see: https://www.rcoa.ac.uk/salg). The key steps were a separate pre-anaesthetic check (similar to those suggested previously [2]), and a new 'stop' moment immediately before needle insertion.

Although logical and persuasive, Stop Before You Block has probably failed to reduce the incidence of wrong-site blocks. At its introduction, National Reporting and Learning Service (NRLS) data indicated 67 wrong-site blocks over 15 months up to November 2010 (~54 year^{-1}) [11]. In 2007, NRLS reported 33 incidents [12] and in 2009, just 27 [11]. In 2015, 34 errors were reported in the 9 months since April 2015 (~45 year^{-1}) [13]. The 5th National Audit Project (NAP5) Activity Survey estimated that 422,000 peripheral nerve blocks are performed annually [14]; this suggests that the mean incidence has been consistently ~ 1 in 6250, with overlapping binomial 95% confidence intervals over years [15, 16]. Other authors agree that the introduction of additional checklists has not reduced the incidence of wrong-site blocks [6].

At least part of the reason for this is the increasingly recognised limitation of checklists themselves [17]. The WHO surgical safety checklist initially produced striking results [3], but these were not confirmed in larger, more recent studies [18]. A central venous catheter checklist in Michigan dramatically reduced infection rates by 66% [19] and led the NHS to adopt a 'Matching Michigan' initiative [20]. Unfortunately and surprisingly, results were ambiguous [21]. Other factors might be a failure or refusal of staff to apply checklists [22], or improved reporting (i.e. previous data were under-estimates).

A more fundamental factor is rooted in neurocognitive psychology. There is a well established difference between perceptions for 'action' and for 'identification' [23]. The first relates to perceptions needed to execute or complete a *task* (e.g. manipulate items to conduct a nerve block). The second relies on the neural system to identify a given *item* (e.g. recognise the

Table 1 List of potential contributory factors involved in wrong-site block [4–6, 9]. The list is not exhaustive.

Operator factors
High pressured environment; overbooked list
Other personal time pressures
Fatigue
Multiple team members with no clear hierarchy or accountability
Poor communication or interpersonal relationships
Change of staff during procedure
Failure to mark site
Failure to check site
Poor recording (inappropriate or misinterpreted abbreviations)
Patient factors
Sedation, confused, or block sited after induction of anaesthesia
Similar patient names
Language/ communication
Abnormal anatomy
Multiple blocks needed in same patient
Haemodynamic instability causing distraction and time pressure
Procedural factors
Change in patient position
Change in operating room or environment
Changes in order of operating list
Wrong site marked
Mark erased or covered
Distractions (phone calls, verbal, staff teaching, entry of other staff, alarms)

correct side). The two perceptions can be readily dissociated such that, humans will actually hold and discard an item (perception for action) that they are seeking, without realising they already had it (failure of identification perception) [24]. Relying upon 'perception for identification' alone 'stop before you block' is therefore predictably unlikely to influence the goal-directed 'perception for action' (conducting the block). The two perceptions need to be actively re-coupled by some type of in-built action check.

Although verbal checklists are claimed to underlie the improved outcomes in the airline industry, Bosk et al. persuasively observe that this is true only for safe take off and landing; they have failed in ensuring baggage gets to where it should [25]. Patient flows in hospitals, they argue, are more akin to the latter, where patients (like bags) come in different shapes and sizes, often in poor condition, requiring multiple, complex interventions in a pathway over time and space. These are tasks needing strong coupling of action and identification perceptions. Specifically, Bosk et al. cite wrong-site interventions as an error probably not amenable simply to introduction of a checklist: "*[To say]: 'If we just tell the workers to use checklists, we will have solved the problem…' is simply the wrong conclusion…*". Something more than a checklist is needed.

A new approach: 'in-built action check' to prevent error

Several observations can serve as basis for developing a safer approach. First is the recognition that performing a block, especially in experienced hands, is a largely subconscious, single, confluent event conducted with fixed purpose. During training, it may be broken down into discrete components, but the very purpose of learning is to create a single, fluid movement. For any block, the process itself rarely offers a natural break in rhythm to facilitate a stop and check moment. After apparently checking the correct site and laying out the sterile tray, the anaesthetist properly regards what follows as seamless and goal-directed: putting the sterile sleeve on the ultrasound; preparing the skin; picking up the syringe; and injecting the solution (often performed with some flair, grace or speed).

This commitment to action is recognised in psychology as a 'point of no return' [26]. Introducing an interruption in the form of a verbal checklist in the midst of this process almost requires the practitioner to 'un-learn' the procedure and re-introduce the hesitancy or doubt that was rigorously eliminated through earlier training. Relying on assistants to introduce the necessary interruption is also not fail-safe, as assistants are also experienced and need to identify an optimum moment in what they too regard as a single movement to interrupt their anaesthetic colleague. Thus, it is important to appreciate that something needs to be built-in to the action itself in order to be effective.

In terms of cognitive psychology, a safe nerve block requires both command (i.e. the strong drive to complete the task) as well as response countermand (i.e. an opportunity, integral to the action, to halt the task) [26, 27]. Examples where command-countermand balance are

necessary for safe task outcome are gently applying brakes when cycling downhill, or slowing and looking over your shoulder before overtaking on a motorway. The countermand slows down the primary task by opposing it, and in fact becomes itself a natural and integral part of the action itself.

Second – and in large part related to the first – is the observation that in many cases of wrong-site block, there has been a significant time delay between performing the 'stop' check and the actual injection [4–6]. Probably because the procedure is a seamless event once started, most practitioners are prone to conduct the stop moment check *before* starting the block, rather than, as recommended, just before inserting the needle. Analyses indicate that, from the team's perspective, the 'stop before you block' was properly completed but nevertheless, a wrong-site injection occurred. The team simply misidentified the site from the very start (akin to failure of identification perception), or something actively distracted them during the time delay.

Third, it is striking that the wrong side injection is noticed immediately (or even during the act of injecting, when it is anyway too late), rather than postoperatively days or weeks after the event [4–6]. Finally, there has never been a case of two successive wrong-site blocks; a second block performed immediately after a wrong-site block is always on the correct side.

Our new proposal is based on these insights. 'Mock Before You Block' in its purest form requires the anaesthetist to prepare an additional, empty syringe (no needle), or empty needle sheath on the sterile tray. The anaesthetist prepares the patient as normal, uses ultrasound if required, but then first picks up the empty syringe/sheath and 'pretends' to perform a (mock) block with it (i.e. touching the skin) and declaring: "*Is the mock block on the correct side?*". This is the important integral, countermanding step to the primary action. Only after positive confirmation is the second, solution-containing syringe (with needle) used to complete the block. If the patient is awake, then the mock-block should be performed before infiltrating any subcutaneous local anaesthetic (Table 2).

The mock-block serves as a action trigger, rather than the verbal trigger in Stop Before You Block, and serves to re-couple action and identification perception. It actually turns to advantage the fact that wrong-site blocks are invariably immediately recognised. Using mock-block, a wrong-site block will require two successive action errors: one at the mock block stage (estimated incidence ~ 1:6520) and one at the true block stage where again, the incorrect site is contacted (estimated incidence ~ 1:6520). Thus, the likelihood of error is ~1 in 39 million (i.e.1:6520^2). This is probably why successive wrong-site blocks are unknown.

Obtaining evidence and variation in methodology

The mock block is itself harmless. However, it will not prevent errors caused by marking the wrong site in the first place, or in cases where there have been errors in the consent process. It is not possible to acquire controlled trial evidence to assess effectiveness, but we note that both the WHO surgery checklist [3] and the Stop Before You Block campaign [10] were introduced without any supportive evidence, but rather with consensus.

We (JM and JJP) have adopted the method into our own practice. Since the vast majority of anaesthetists have not performed or witnessed a wrong-site block, most trainees assigned to us were nonplussed or mystified at the 'mock

Table 2 Summary of steps to take to adopt the 'Mock Before You Block' in clinical practice.

1	Check and identify patient and site of surgery/block in anaesthetic room on arrival*
2	Induce anaesthesia (or move to step 3 if performing block awake)
3	Position patient/limb, prepare block tray, prepare and clean skin, scrub for conducting block (in whichever suitable order)
4	Use sterile empty syringe† and state: "*Mock block: is it the correct site?*"‡
5	If assistant confirms, and this reconciles with anaesthetist opinion, proceed with true block§

*Some practitioners would perform Stop Before You Block at this stage.
†Alternatively can be used: a gloved finger; sterile ultrasound probe; sterile empty needle sheath; or the site can be signed with sterile marker pen or marked with a sterile label.
‡Note that this becomes, in effect, the Stop Before You Block moment.
§If the mock block is identified as on wrong side, then repeat procedure on correct side.

block' step as something they had not encountered before. Although they understood the logic, they did not assign any importance to the step, over and above identifying the correct site for block. Furthermore, when performing a block under supervision, they frequently forgot to implement the mock block. In contrast, responses from colleagues who had experienced a wrong-site block have been overwhelmingly positive, as they better understood the safety potential. We observed the dramatic effect of a wrong-site mock block. A distracted assistant and trainee failed to notice the wrong site being prepared, even after a correct 'stop before you block' check. However, making a mock block declaration elicited initial surprise, followed by disbelief (at their own oversight), followed by expressions of huge relief that a mock block, and not a real block, had been performed.

We can anticipate suggestions to modify the mock block, but to be effective all these would have to be conducted after preliminary site identification and sterile preparation of skin, just before true injection. These might include: using a sterile gloved finger or the sterile ultrasound probe rather than empty syringe; signing the site with one's own signature (or other unique mark); or applying a sterile label/dressing to re-mark the site. All of these need careful consideration (e.g. adding extra skin marks/labels could further confuse). A recent suggestion to label the injecting syringe [26] serves only as a further visual aid, without itself interrupting the action.

To be truly effective, it is essential to make the mock block step a mandatory part of all blocks, in exactly the same way as intravenous access, minimum monitoring and skin preparation are all considered prerequisites to performing any regional anaesthetic technique. We recognise that experts in regional blockade may be slow to adopt this. However, trainees can and should be taught the method from early on. In postgraduate examinations, candidates currently can only pass a question on regional anaesthesia if they begin "*I will establish consent, intravenous access, monitoring etc. . .*". We now hope and anticipate that they must henceforth be expected also to say: "*. . .I will then perform a mock block, which will trigger a 'stop-before-you-block' check.*" In this manner, 'mock before you block' is not designed to replace 'stop before you block'. Rather, it strengthens the check moment by introducing a natural break (countermand response/in-built action check), to encourage the 'stop before you block' to be performed at its correct time. Relying on 'stop before you block' in isolation as an audiovisual cue has not proved enough.

It will be important to assess the acceptability of our proposal in clinical practice; although we have found it straightforward to adopt, there may be unforeseen problems. Testing the method in simulation will be important, particularly to investigate the psychology of team reactions to wrong-site mock block. Most importantly, we hope to stimulate debate about whether there is a better alternative suggestion for an in-built action check, which is the unique notion upon which our approach rests. Finally, we note that there may be scope to apply the general principle more widely (e.g. by way of a mock incision) to help prevent wrong-site surgery.

Competing interests

JP is an elected Member of Council, Royal College of Anaesthetists, and Chair of SALG. He also sits on the new national Expert Panel, Patient Safety, NHS Improvement. The views expressed are his own and not of these organisations. No other funding or competing interests declared.

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References

1. Edmonds CR, Liguori GA, Stanton MA. Two cases of a wrong-site peripheral nerve block and a process to prevent this complication. *Regional Anesthesia and Pain Medicine* 2005; **30**: 99–103.
2. Stanton MA, Tong-Ngork S, Liguori GA, Edmonds CR. A new approach

to pre-anesthetic site verification after 2 cases of wrong site peripheral nerve blocks. *Regional Anesthesia and Pain Medicine* 2008; **33**: 174–7.
3. Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *New England Journal of Medicine* 2009; **360**: 491–9.
4. Cohen SP, Hayek SM, Datta S, et al. Incidence and root cause analysis of wrong-site pain management procedures: a multicenter study. *Anesthesiology* 2010; **112**: 711–8.
5. Barrington MJ, Uda Y, Pattullo SJ, Sites BD. Wrong-site regional anesthesia: review and recommendations for prevention? *Current Opinion in Anaesthesiology* 2015; **28**: 670–84.
6. Hudson ME, Chelly JE, Lichter JR. Wrong-site nerve blocks: 10 yr experience in a large multihospital health-care system. *British Journal of Anaesthesia* 2015; **114**: 818–24.
7. Moppett IK, Moppett SH. Surgical caseload and the risk of surgical Never Events in England. *Anaesthesia* 2016; **71**: 17–30.
8. Pandit JJ. Deaths by horsekick in the Prussian army – and other 'Never Events' in large organisations. *Anaesthesia* 2016; **71**: 7–11.
9. O'Neill T, Cherreau P, Bouaziz H. Patient safety in regional anesthesia: preventing wrong-site peripheral nerve block. *Journal of Clinical Anesthesia* 2010; **22**: 74–7.
10. Chikkabbaiah V, French J, Townsley P, Bedforth N. Further reducing the risk of wrong site block. *Anaesthesia* 2015; **70**: 1453.
11. National Patient Safety Agency. *Alert: NPSA/2009/PSA002/U1. WHO Surgical Safety Checklist*. January 2009.
12. National Patient Safety Agency, Patient Safety Division. *National Reporting and Safety System Data Summary*. London: NPSA, 2007.
13. NHS England. Never Events Data. At: https://www.england.nhs.uk/patientsafety/never-events/ne-data/ (accessed 10/07/2016).
14. Pandit JJ. Gambling with ethics? A statistical note on the Poisson (binomial) distribution. *Anaesthesia* 2008; **63**: 1163–6.
15. Sury MR, Palmer JH, Cook TM, Pandit JJ. The state of UK anaesthesia: a survey of National Health Service activity in 2013. *British Journal of Anaesthesia* 2014; **113**: 575–84.
16. Pandit JJ. If it hasn't failed, does it work? On 'the worst we can expect' from observational trial results, with reference to airway management devices. *Anaesthesia* 2012; **67**: 578–83.
17. Anthes E. Hospital checklists are meant to save lives – so why do they often fail? *Nature* 2015; **523**: 516–8.
18. Urbach DR, Govindarajan A, Saskin R, Wilton AS, Baxter NN. Introduction of surgical safety checklists in Ontario, Canada. *New England Journal of Medicine* 2014; **370**: 1029–38.
19. Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *New England Journal of Medicine* 2006; **355**: 2725–32.
20. Bion J, Richardson A, Hibbert P, et al. 'Matching Michigan': a 2-year stepped interventional programme to minimise central venous catheter-blood stream infections in intensive care units in England. *BMJ Quality and Safety* 2013; **22**: 110–23.
21. Dixon-Woods M, Leslie M, Tarrant C, Bion J. Explaining Matching Michigan: an ethnographic study of a patient safety program. *Implementation Science* 2013; **8**: 70.
22. Reed S, Ganyani R, King R, Pandit M. Does a novel method of delivering the safe surgical checklist improve compliance? A closed loop audit. *International Journal of Surgery* 2016; **32**: 99–108.
23. Goodale MA, Milner AD. Separate visual pathways for perception and action. *Trends in Neurosciences* 1992; **15**: 20–5.
24. Solman GJ, Cheyne JA, Smilek D. Found and missed: Failing to recognize a search target despite moving it. *Cognition* 2012; **123**: 100–18.
25. Bosk CL, Dixon-Woods M, Goeschel CA, Pronovost PJ. Reality check for checklists. *Lancet* 2009; **374**: 444–5.
26. Liddle EB, Scerif G, Hollis CP, et al. Looking before you leap: a theory of motivated control of action. *Cognition* 2009; **112**: 141–58.
27. Chikkabbaiah V, French J, Townsley P, Bedforth N. Further reducing the risk of wrong site block. *Anaesthesia* 2015; **70**: 1453.

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