The modern anaesthetic machine is a complex device. It has evolved from a ‘trolley’ that did little more than deliver gas to the patient, into a ‘workstation’ with multiple delivery modalities, multiple safety features and multiple integrated monitoring devices. In addition, we have at our disposal many more pieces of complex equipment, separate from the anaesthesia workstation itself, to help ensure our patients’ safety while in our care. Yet patients still can, and do, come to significant harm due to failure of any part of the anaesthetic equipment, whose function has not been adequately checked before use.

With such complexity it may be tempting for some users to abrogate responsibility for understanding the function of components, or what constitutes their safe conditions of use. The anaesthetic machine is treated as a ‘black box’, whose internal workings are a technical mystery; after all, we are clinicians not engineers. However, as intelligent and learned users of our equipment, and more importantly, as professionals who have our patients’ safety as our highest priority, we have a responsibility to do a great deal better than that. We have well-trained operating department assistants who check equipment for us, but we are responsible to the patient for ensuring our own knowledge and training and for doing our own checks. In the relentless drive for efficiency in the National Health Service (NHS), it is important that anaesthetists do not allow the equipment check to be omitted or abbreviated. The Association of Anaesthetists of Great Britain & Ireland (AAGBI) exhorts us to be vigilant towards patient safety in the use of equipment, even if the pace of equipment development outstrips safe recommendations in its use, or if written standards become inappropriate [1]. Knowledge of equipment and safety is an integral part of the FRCA Primary Examination, and includes testing, at an early stage of a career, the candidate’s ability to check the safe function of an anaesthetic machine. Additionally, in order to reduce their own vicarious liability for our actions, our NHS employers require us to adhere to protocols that demonstrably enhance patient safety. As a result, checklists for many procedures have become routine in our working lives, in order that important details are not omitted in a long list of complex functions and processes [2]. Other industries have used checklists for years to improve user competence and customer safety, notably the aviation [3] and nuclear power industries [4]. The modern anaesthetic machine is a complex hybrid of mechanical engineering and electromedical equipment, and both the International Standards Organization [5] and the International Electrotechnical Commission [6] continue to evolve standards to ensure the safe design and implementation of anaesthetic workstations and electromedical equipment. The critical importance of the safe use and checking of anaesthetic equipment is recognised by our colleagues internationally, although some recommendations have been updated more recently than others [7–13]. Hence the AAGBI has produced a timely UK update of its 1997 and 2004 checklists for enhancing the safe function of the anaesthetic machine and its associated equipment before use [14], although it is noted that this update was intended as long ago as 2009 [15].

It is an art to develop a checklist that is not so simplistic as to be functionally useless to users of many different types of workstations, yet not so complex as to tempt the user to bypass it, in the belief that the integral self-test carried out by modern machines on powering up will suffice. The checklist emphasises the requirement to check all the equipment we use, not just the gas delivery system of the anaesthetic machine and its integrated monitoring. The detailed guideline document tells us what to do and why, but if the machine check is part of our daily routine, this can be done very quickly; anomalies are rapidly detected by pattern recognition, so the checks...
need not be time consuming. In particular, the 2012 detailed guideline document links specific checks to comprehensible outcomes, which makes it less likely we will omit any part of it. It is salutary that we are reminded that those outcomes are informed by incidents reported to the Medical and Healthcare products Regulatory Agency [16]. It also demonstrates by its completeness that the integral self-test carried out by the machine is far from complete, yet recognises that at least some of the checks need not be repeated; it pointedly omits any detail in this respect, because machines have different processes associated with the integral self-test procedures. Manufacturers’ recommendations for checking should be used in conjunction with the AAGBI checklist, and this will require us actually to read that part of the machine’s user manual to determine what functions have been self-tested and how; it may take some practice to mesh this efficiently with the AAGBI checklist, but will ultimately save time and enhance patient safety. Training and familiarity with the function of an anaesthetic machine and other equipment before use is stressed, as is doing checks before the operating list starts, as well as between patients or after a critical incident. Drafts of the checklist have evolved with input from AAGBI membership and manufacturers, and tested against workstation simulators, which is to be commended. While the checklist claims to be adequate for all contemporary workstations, it is not clear how it is necessarily suitable for machines yet to be developed.

Although most modern anaesthetic record charts have a tick-box to confirm that the anaesthetic machine has been checked, the 2012 checklist emphasises that a record of the check should also stay with the machine, alongside the record of the service checks by the manufacturer’s engineer, which is a useful audit tool. The first post-service check is especially important. As in the 2004 checklist, the laminated glossy version conveniently divides the ‘pre-use’ checklist on the front side from the ‘pre-case’ checklist on the reverse.

The order of checking components in the checklist has some major changes compared to the 2004 checklist. Section A has rightly become checking the availability of an alternative means of ventilation as a self-inflating bag and a source of oxygen when all else fails, a safety measure often overlooked. Section B is carrying out the manufacturer’s check, since the automatic self-check is still likely to become the first thing that happens after powering up. Section C exhorts the user to check the power supply, including back-up batteries; the user should know which part of the machine and its monitoring is backed up, since not all of it may be. This section is not now followed directly (as in previous versions) by ‘monitoring equipment’, which has been relegated to section I, a change that probably reflects the reliability of contemporary monitoring devices. Instead, section D continues with checking gas supplies and suction (suction had been previously relegated to ‘ancillary equipment’ in the 2004 version). The section starts by emphasising the testing of the oxygen failure warning device on a machine before use. It is not always desirable or necessary to disconnect and reconnect the oxygen pipeline every day if there is a gas supply switch on the machine to do this test; however, the ‘tug test’ should be performed daily in case wear and tear of the Schräder valve has compromised the oxygen pipeline connection. It is important for the user to know what the oxygen failure alarm sounds like, what gas shut-off mechanism is in use and what gas flow is left after oxygen failure; this system must therefore be checked weekly by oxygen hose disconnection. The section continues with the remaining checks of the medical gas supply, with no change from the 2004 document, and with the additional paragraph on checking the suction. Section E covers the checking of whole breathing systems, vapourisers and the carbon dioxide absorber, alternative breathing systems and the correct gas outlet, which is a departure from the 2004 guidance. The integrity of the whole system should be checked by a pressure test, and the connections by ‘pushing and twisting’ (rather than just pushing), a detail that is often omitted. We are reminded to check the visual and functional configuration of the breathing system, especially when the system is changed between cases. We are also reminded of the ‘two-bag test’ for any breathing system, and of the occlusion test for coaxial systems. Given the widespread use of low flow circle system, it is odd that a more detailed testing of its components is not outlined, although a sentence is added on the integrity of the carbon dioxide absorber. We are also cautioned that damage may occur doing a pressure leak test on a vapouriser on modern machines, but are asked to consult the manufacturers’ guide-
lines. Decades ago some anaesthetic machines had more than one gas outlet, and it took some evolutionary development to ensure the added safety of just one common gas outlet; some 21st century workstations have once again reverted to the potential hazard of having an auxiliary gas outlet, and the 2012 checklist stresses the importance of avoiding accidental connection to it.

Sections F and H, covering ventilators and scavenging, respectively, are unchanged, as is Section I on monitoring equipment, except for reminding us of the presence of default alarm limits that may not be appropriate for the intended use (see the AAGBI document on monitoring (17)); we are reminded of the potential of badly secured gas monitoring lines as a significant cause of leak where low fresh gas flow is in use. There is a new section G describing the ‘two-bag test’, with which not all users will be familiar. Section J is a new section on airway equipment, including laryngoscopes and airway devices, and equipment for difficult intubations.

Section K is new and discusses checking of systems for total intravenous anaesthesia (TIVA). It reminds us, through data from the Safe Anaesthesia Liaison Group, that faults in these devices can and do cause awareness, and that anaesthetists should be trained in the technique and recognise its limitations. It stresses the need for a non-return one-way valve in the delivery system, the visibility of the infusion site, and clear labelling of lines.

Section L on ancillary and resuscitation equipment adds to the 2004 document a sentence on checking the presence of a resuscitation trolley and defibrillator, and on rarely encountered drugs and equipment (such as for malignant hyperthermia).

Sections M and N on single-use devices and machine failure remain unchanged from 2004, and a new section, O, on responsibility for ‘shared equipment’ (such as diathermy) reminds the anaesthetist not to be distracted from his/her primary function by the malfunction of such equipment. Section P on recording and audit rather laboriously repeats earlier statements about the importance of recording checks for audit purposes, reminding us that the automatic self-test may be recorded by the machine itself. One final additional section Q reminds us that the recovery ward is also a site where a policy for checking equipment is required.

In the abbreviated laminated versions of the checklist, the sequence of checks is the same as the detailed guidelines, but some important steps are relegated to a brief ‘Don’t Forget’ section at the end. Somewhat surprisingly these include checking equipment for TIVA, resuscitation and difficult intubation, and the accessory common gas outlet. The abbreviated version exhorts recording the check in the anaesthetic record, but does not mention doing so in the workstation’s logbook.

The even more abbreviated ‘pre-case’ checklist itemises the relevant parts of the pre-use checklist, including suction. There is additionally a useful reminder of the ‘two-bag’ test.

In summary, the 2012 version of the equipment checklist has, I believe, successfully updated the 2004 version alongside developments in practice and equipment. The authors are to be congratulated.

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References
Type of anaesthesia for hip fracture surgery – the problems of trial design

The UK National Institute for Health and Clinical Excellence (NICE) has recently proposed that a randomised controlled trial (RCT) be performed to assess the clinical and cost effectiveness of regional versus general anaesthesia on postoperative morbidity in patients undergoing surgery for hip fracture [1]. Such a recommendation is likely to stimulate large research grant applications to the National Institute for Health Research (NIHR) in future.

To date, strong evidence for the clinical and cost benefit of one mode of anaesthesia compared with the other has been minimal, even though this would seem to be an important research question to answer, given the current and projected increases in postoperative mortality, bed occupancy and cost associated with hip fracture within an aging population [3], but the fact that an RCT involving hip fracture patients has not been recently attempted is informative, and indicates that the design of such an RCT is considerably more complex than it appears at first sight. Furthermore, given the current evidence base, it may not even be possible to consider the definitive RCT for a number of years until preparatory trials have been concluded; in the current financial climate, grant-awarding bodies might be better advised to spend their money on programmes of research, rather than a single 'headline' RCT.

Four main problems exist in trying to design such an RCT,