

# Anaesthesia Machine: Checklist, Hazards, Scavenging

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## ABSTRACT

From a simple pneumatic device of the early 20<sup>th</sup> century, the anaesthesia machine has evolved to incorporate various mechanical, electrical and electronic components to be more appropriately called anaesthesia workstation. Modern machines have overcome many drawbacks associated with the older machines. However, addition of several mechanical, electronic and electric components has contributed to recurrence of some of the older problems such as leak or obstruction attributable to newer gadgets and development of newer problems. No single checklist can satisfactorily test the integrity and safety of all existing anaesthesia machines due to their complex nature as well as variations in design among manufacturers. Human factors have contributed to greater complications than machine faults. Therefore, better understanding of the basics of anaesthesia machine and checking each component of the machine for proper functioning prior to use is essential to minimise these hazards. Clear documentation of regular and appropriate servicing of the anaesthesia machine, its components and their satisfactory functioning following servicing and repair is also equally important. Trace anaesthetic gases polluting the theatre atmosphere can have several adverse effects on the health of theatre personnel. Therefore, safe disposal of these gases away from the workplace with efficiently functioning scavenging system is necessary. Other ways of minimising atmospheric pollution such as gas delivery equipment with negligible leaks, low flow anaesthesia, minimal leak around the airway equipment (facemask, tracheal tube, laryngeal mask airway, etc.) more than 15 air changes/hour and total intravenous anaesthesia should also be considered.

**Key words:** Anaesthesia machine, anaesthesia workstation, checklist, hazards, scavenging

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## INTRODUCTION

Anaesthesia machine is designed to deliver O<sub>2</sub> along with other anaesthetic gases including volatile anaesthetic vapours in specified concentrations to patients with the help of breathing circuits. From a simple pneumatic device of the early 20<sup>th</sup> century, the anaesthesia machine has evolved to incorporate various mechanical, electrical and electronic components to be more appropriately called anaesthesia workstation.<sup>[1]</sup> The focus of this article is to format a concise anaesthesia machine check protocol, discuss the hazards related to modern anaesthesia machines and detail the requirements for an efficient scavenging system.

## ANAESTHESIA MACHINE CHECK PROTOCOL

Checking each component of anaesthesia machine for appropriate functioning prior to use is essential

to ensure patient safety. However, a single checklist cannot satisfactorily test the integrity and safety of all existing anaesthesia machines due to their complex nature as well as variations in design among manufacturers. An in-depth and elaborate anaesthesia machine check should be done following servicing of the anaesthesia machine. Further, machine check should be done daily prior to first use [Figure 1]. This should be user friendly and less time consuming while also ensuring satisfactory check of all components of the machine. Minor check procedure should be followed between anaesthetic conducts.

First priority is to ensure the machine is placed in a safe area and its electrical wiring safely secured. Despite advanced technology, a remote but life-threatening possibility of intraoperative machine malfunction exists. Therefore, presence of a functioning self-inflating bag appropriate for the patient's age and

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<p><b>Self-inflating bag appropriate for patient's age and an alternate O<sub>2</sub> source available</b></p> <p>Machine and wiring secured safely</p> <p>Power source plugged on, battery backup-sufficient and charging</p> <p>Pipelines-Quick coupling, tug test, sufficient pressures present</p> <p>Cylinders-Pin indices, fitted correctly, <b>sufficient gas present (to be checked again if cylinder content is utilised)</b></p> <p>Oxygen fail safe mechanism intact-Single hose test, hypoxic guard functioning, high pitch alarm on discontinuation of O<sub>2</sub></p> <p>Oxygen flush works appropriately</p> <p>Machine leak check-first with vaporiser off, next with individual vaporiser turned on <b>(to be performed again if any vaporiser was replaced)</b></p> <p>Flow meters working appropriately through full range of flows</p> <p>Vaporisers in upright position, <b>filled adequately</b></p> <p>Oxygen analyser calibrated</p> <p><b>Breathing system checked for leak, functioning of one way valves, appropriate breathing system chosen, sufficient fresh CO<sub>2</sub> absorbent present</b></p> <p><b>Ventilator-functioning appropriately, appropriate ventilator and alarm settings for patient's age</b></p> <p><b>Suction apparatus-functioning well</b></p> <p>Monitors-SpO<sub>2</sub>, ETCO<sub>2</sub>, NIBP can be checked on self, <b>alarm settings adjusted to patient requirements, unwanted monitors turned off, monitor tubing leak free and kink free</b></p> <p>Scavenging system appropriately connected and functioning well</p>
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**Figure 1:** A concise anaesthesia machine checklist for daily use (content in bold indicates minor check procedure that should be followed between anaesthetic conducts). The checklist should be modified to suit the type of anaesthesia machine / workstation available at individual location

alternate O<sub>2</sub> source should be ensured.<sup>[2,3]</sup> Modern anaesthesia machine check includes the cylinders, pipelines, machine proper (both intermediate and low pressure systems and components thereof), vapourisers, breathing circuits, monitors, integrated ventilator, suction apparatus and the scavenging system. However, several modern machines perform self-check as soon as the master switch is turned on. Unnecessary repetition and missing of some component check can be prevented with adequate understanding of the components tested during self-check.

Several international guidelines are available for anaesthesia machine check.<sup>[2-5]</sup> The following protocol was developed based on the existing literature and our department practices, which involves the checking for the pneumatic, electrical, electronic and other components of the machine in a systematic manner.

### Checking the pneumatic components of anaesthesia machine

#### Checking the integrity of the high pressure system

- Ensure the master switch is off, pipelines disconnected, cylinders completely closed

and remaining gases in the system exhausted (pressure gauges reading zero). Confirm each cylinder by colour coding and label. Confirm proper attachment to the machine through the hanger yoke assembly.

- Open O<sub>2</sub> cylinder with cylinder key by full 3½ rotations anticlockwise. Confirm the cylinder is at least half full (>7000 kPa or 1000 psi). Open O<sub>2</sub> flow control valve (anticlockwise rotation of knob) and confirm the O<sub>2</sub> flow meter registers flows (further confirmation of O<sub>2</sub> can be done by O<sub>2</sub> analyser). Open N<sub>2</sub>O flow control valve and confirm N<sub>2</sub>O flow meter doesn't register flows. Close the O<sub>2</sub> cylinder, wait until the flow reaches zero and the O<sub>2</sub> pressure gauge reads zero.
- Checking the integrity of N<sub>2</sub>O slave mechanism and oxygen pressure fail-safe mechanism: With the O<sub>2</sub> supply off, open N<sub>2</sub>O cylinder fully and confirm the N<sub>2</sub>O pressure gauge reads > 5000 kPa or 750 psi (lesser pressures mean exhaustion of liquid N<sub>2</sub>O). Open N<sub>2</sub>O flow control valve and confirm the absence of flow in the N<sub>2</sub>O flow meter (presence of flow indicates a defect). Open both O<sub>2</sub> cylinder and O<sub>2</sub> flow control valve (if not already open). Confirm both O<sub>2</sub> and N<sub>2</sub>O flow meters now register flows. Close the O<sub>2</sub> cylinder and flush the O<sub>2</sub> to confirm flows return to zero in both the O<sub>2</sub> and N<sub>2</sub>O flow meters.
- Oxygen flush should function even with the master switch and O<sub>2</sub> flow meter turned off as long as O<sub>2</sub> supply to the machine is ensured. The O<sub>2</sub> flush should stop as soon as the pressure on the O<sub>2</sub> flush knob is taken off.
- Close the O<sub>2</sub> and N<sub>2</sub>O cylinders and turn off the flow control valves for both gases.

#### Checking the integrity of the intermediate pressure system

- Tug test: Connect O<sub>2</sub> pipeline to the oxygen wall outlet using the Schrader quick coupler system. Correct coupling will not allow detachment of the pipeline from the Schrader coupler when a tug is given to the pipeline. Similar test can be performed with the N<sub>2</sub>O pipeline with N<sub>2</sub>O wall outlet.
- Single hose test: Disconnect N<sub>2</sub>O pipeline while retaining the O<sub>2</sub> pipeline intact. Open the O<sub>2</sub> flow control valve to note O<sub>2</sub> is flowing (further confirmation of O<sub>2</sub> can be done by oxygen

analyser). Open N<sub>2</sub>O flow control valve which may show initial flows (residual N<sub>2</sub>O in the system) that subsequently falls to zero. Connect the N<sub>2</sub>O pipeline to its wall outlet and note again there is flow in the N<sub>2</sub>O flow meter. These steps help detect accidental mix up of O<sub>2</sub> and N<sub>2</sub>O pipeline connections. Disconnection of O<sub>2</sub> pipeline should result in both flow meters registering zero flows and activation of the oxygen fail-safe mechanism.

- c. Connect O<sub>2</sub> and N<sub>2</sub>O pipelines again and note their pressure gauges read >400 kPa or 55-60 psi (to ensure supply from the manifold room is at correct pressures).

#### Checking integrity of the low pressure system

This is performed after the following set up is established with the master switch on: Pipelines of O<sub>2</sub> and N<sub>2</sub>O intact, cylinders closed or in the absence of pipelines, cylinders open.

- a. Close the flow control valves, place vapourisers in their location on the machine with vapouriser dial turned off. Confirm sufficient liquid volatile agent and the filler cap is tightly shut. Ensure vapourisers are upright and not tilted (this prevents unsafe delivery of vapours).
- b. Universal negative pressure leak test: Turn master switch off and close all the flow control valves, attach suction bulb to the common gas outlet and repeatedly squeeze to empty its contents until the bulb is well collapsed. The bulb should remain collapsed for at least 10 s. To test for leaks in the vapourisers, individual vapouriser should be turned on and above mentioned steps be repeated. Re-inflation of the bulb within next 10 s indicates a leak in the low pressure system (when the vapouriser is off) or vapouriser (if an individual vapouriser is turned on during the test). At the end of this test, put the master switch on, remove the suction bulb and connect breathing apparatus.
- c. Open individual flow meters to their maximum range to confirm proper functioning of the Thorpe's tubes and the float. Confirm anti-hypoxic mechanisms are working satisfactorily through various ranges of O<sub>2</sub> and N<sub>2</sub>O flows.

#### Checking the electrical/electronic components of anaesthesia machine

- a. Turn the master switch on and confirm proper working of all other associated electrical or electronic equipment. If the machine has

minimum mandatory flows, confirm O<sub>2</sub> flow meter registers a flow of around 50-200 mL with the O<sub>2</sub> flow control valve turned off.

- b. Confirm anaesthesia machine is connected to the mains (AC source) and the switch is on. Ensure the battery has at least 30 min back up supply and is charging during machine use.
- c. Monitor: Check appropriate functioning of SpO<sub>2</sub>, non-invasive blood pressure (NIBP), end tidal capnogram (ETCO<sub>2</sub>), etc., by using them on self (e.g., SpO<sub>2</sub> on our finger >96%, exhalation into capnograph port registers a CO<sub>2</sub> waveform, etc.) and adjust alarm settings according to patient profile. Ensure monitoring equipment including gas sampling lines are secured leak free and kink free. Gas sampling line must be connected proximal to the airway filter to avoid frequent obstruction by moisture. Monitoring parameters not required for a given patient should be turned off.
- d. Oxygen analyser calibration (21% to >95%): Calibrate the analyser to read 21% at atmosphere. With the O<sub>2</sub> source from cylinder (pipeline source disconnected), open O<sub>2</sub> flow control valve and connect the analyser to the common gas outlet and calibrate to register at least 95%.

#### Checking other components of the anaesthesia machine

Most of the modern machines have the facility for connecting both circle system and Mapleson breathing system in such a way that just by turning a knob the desired breathing system can be put to use. Ensure the breathing circuit intended for use on the patient is correctly chosen (check the knob position).

- a. Circle system: Verify adequate fresh CO<sub>2</sub> absorbent and its proper attachment to the machine. Make all necessary connections of circle system components. Perform the leak test by occluding the patient end of the breathing circuit. Either increase O<sub>2</sub> flows or use O<sub>2</sub> flush to pressurise the breathing apparatus to >30 cm H<sub>2</sub>O. Turn the O<sub>2</sub> flow control valve off and stop O<sub>2</sub> flush. Drop in airway pressures to <30 cm H<sub>2</sub>O within 10 s indicate a leak in the system. Further quantification of the leak can be done by increasing the O<sub>2</sub> flows in small increments until the pressures can be sustained >30 cm H<sub>2</sub>O. The system pressure should be released by opening the APL valve. This ensures proper functioning of the APL valve and prevents

accidental entry of the absorbent dust into the breathing system. Simultaneously, evaluate for appropriate response and functioning of the unidirectional valves.

- b. The integrity of individual Mapleson system should be tested but describing these is beyond the scope of this article.
- c. Ventilator: With the breathing system *in situ* and the patient end occluded, turn on the ventilator knob to evaluate the integrated ventilator. In case of ascending bellows, ensure the bellows reach the top of the bottle and then turn off the fresh gas flows. The bellows should continue to reach the top of the bottle at the end of each ventilator breath. Failure of the bellows to reach the top indicates leak. However, in case of descending bellows, this cannot be verified. Verify ventilator settings appropriate for the patient's weight and adjust alarm settings accordingly.
- d. Check appropriate connection of the scavenging system to the machine and its correct functioning.
- e. Ensure suction apparatus is working appropriately and sufficient negative pressures are rapidly developed when its port is occluded.
- f. Pay attention to any notes attached to workstation such as last servicing date, last time the CO<sub>2</sub> absorbent was changed, etc.
- g. When the breathing circuit is not in use, patient end must be covered with sterile layer. Common practice in our department is to place the patient end in a sterile glove.

Overall time taken for this protocol does not exceed 10 min. This duration might further be reduced if the machine is capable of self-check for its components. Between two anaesthetic conducts, any new equipment intended for use on next patient such as suction tubing, breathing circuitry, etc., should be tested. Verify sufficient availability of fresh CO<sub>2</sub> absorbent and volatile anaesthetic liquid. If O<sub>2</sub> cylinder was used for any reason, confirm the cylinder is at least half full or change to a new full cylinder. During the anaesthetic conduct, in the event of change of anaesthesiologist, proper hand over must be given regarding the machine check and functioning of all the components. In long duration procedures, periodically check for exhaustion of volatile anaesthetic liquid and CO<sub>2</sub> absorbent. A detailed check is required following any critical event if suspected to be due to workstation.

Clear documentation of regular and appropriate

servicing of the anaesthesia machine, its components and their satisfactory functioning following servicing and repair is important. Finally, anaesthesiologist should be aware of manufacturing differences in the components and their functioning and should develop a machine check protocol convenient for their set up.

## HAZARDS OF ANAESTHESIA MACHINES

Main problems related to older anaesthesia machines can broadly be classified into delivery of lower inspired oxygen concentrations, delivery of dangerously high or low concentrations of volatile anaesthetic agents, insufficient ventilation, excessive airway pressures, foreign bodies, hyperventilation and miscellaneous.<sup>[1,6]</sup> Misfilling of cylinders, misconnections of pipelines or cylinders, delivery of 100% N<sub>2</sub>O (in the absence of hypoxic guard, N<sub>2</sub>O can be administered without opening oxygen flow control valve due to variations in the arrangement of O<sub>2</sub> flow meter in relation to others), leak at the flow meter assembly or vapourisers, etc., contributed to hypoxic gas delivery.<sup>[1,6]</sup> To prevent this, several measures have been incorporated such as quick coupler system and diameter index safety system for pipelines, pin index safety system and colour coding for cylinders, O<sub>2</sub> failure safety devices (gas proportionating devices) to ensure minimum 25% O<sub>2</sub> supply by rendering the N<sub>2</sub>O a slave to O<sub>2</sub> pressures, O<sub>2</sub> gas downstream of other flow meters and use of O<sub>2</sub> analyser. The dangers related to vapourisers have been minimised by the incorporation of keyed index safety system for filling vapourisers and temperature-compensating technology while negative pressure leak test prior to use of vapourisers detects any leak in the vapourisers. Excessive pressure build-up was observed by obstruction in the pipeline, machine or circuitry to flow of gases by dust, blood, secretions, foreign bodies, stuck valves, etc., Insufficient ventilation could be attributed to leaks in the machine or breathing system. These have been minimised by incorporating integrated monitoring along with alarm systems for tidal volume, minute ventilation, airway pressures, etc., and diligent protocols for machine and breathing circuit check.<sup>[1,6]</sup>

Modern machines have overcome many drawbacks associated with the older machines. However, addition of several mechanical, electronic and electric components has contributed to recurrence of some of the older problems such as leak or obstruction attributable to newer gadgets and development of newer problems. Our pubmed search for hazards



associated with anaesthesia machines from the year 2000 onwards yielded several results indicating continued occurrence of machine related hazards. Although human errors cannot be attributed to machine, several problems were triggered by the modern machines and their components.

#### **Hypoxic gas delivery due to problems with cylinders, pipelines, anaesthesia machines**

Hypoxic gas delivery is still a distinct possibility. Development of a stricture in the O<sub>2</sub> central supply system outlet as a result of degradation of the O-ring and a structural defect in the pipeline delivery at the ceiling level of the operating room resulting in accidental switching off of the O<sub>2</sub> supply valve by the N<sub>2</sub>O pipeline have contributed to delivery of hypoxic gas mixtures.<sup>[7,8]</sup> Misconnection of O<sub>2</sub> pipeline hose to N<sub>2</sub>O cylinder in the manifold room by technical personnel has resulted in hypoxic gas delivery.<sup>[9,10]</sup> Insertion of the Equanox (50% each of O<sub>2</sub> and N<sub>2</sub>O) probe accidentally into the N<sub>2</sub>O wall outlet resulted in 100% N<sub>2</sub>O delivery.<sup>[11]</sup> These problems were compounded by either lack of oxygen analyser or failure to recognise the hypoxia early and changing over to an alternate plan by the concerned anaesthesiologist. Fault in the chain-link mechanism of Ohmeda Excel 210 SE where loosening of the stop screw which placed over the O<sub>2</sub> flow control knob contributed to hypoxic gas delivery.<sup>[12-14]</sup> Faulty interface between gear wheels of O<sub>2</sub> and N<sub>2</sub>O flow meters in ageing machines contributed to failure of the flow proportionating devices while defective rubber seal of flow meter control tube was responsible for hypoxic gas delivery.<sup>[15,16]</sup>

#### **Other reported hazards due to problems within the anaesthesia machine or workstation**

Advances in technology contributed to the development of piston-driven ventilators in place of bellow operated ventilators. Resetting of a ventilator piston following suctioning of the airway during one-lung ventilation resulting in inability to ventilate is reported.<sup>[17]</sup> Improperly fitted retaining ring (placed between the expiratory valve assembly and the spiromed respiratory volume monitor) of the Narkomed 4 anaesthesia system contributed to gas leak.<sup>[18]</sup> Accidental obstruction to exhaust gas port of a ventilator by a vinyl bag resulted in ventilatory failure.<sup>[19]</sup> Awareness under anaesthesia occurred due to a disconnection of the common gas outflow tract prior to one way check valve of the anaesthesia machine while a to-and-fro type of anaesthesia ventilator operated without any problem.<sup>[20]</sup>

The APL valve has resulted in leak in the breathing system and kinking of the sampling ports.<sup>[21-30]</sup> Improper seating of the vapourisers over the back bar, faulty locking spring on the vapouriser and broken transverse pin of the desflurane vapouriser contributed to gas leak.<sup>[31-35]</sup> During the process of filling of an isoflurane vapouriser, accidental spillage of the liquid caused corrosion and damage to the water trap while accidental lifting up of the lever of the Tec 5 isoflurane vapouriser resulted in damage to the water trap in Draeger machines.<sup>[36-40]</sup>

#### **Hazards due to breathing systems and their use with newer anaesthesia machines**

Hypercarbia and related problems are reported with faulty Bain's circuit and adult co-axial breathing circuits.<sup>[41,42]</sup> Most of the modern machines have integrated circle system as one of their main components to enable the economy of gases and minimise atmospheric pollution. However, numerous possibilities for misconnections exist with circle system. In fact, a closed claims analysis revealed problems in breathing circuitry connections contributed to 35% adverse anaesthetic outcomes arising from gas delivery systems.<sup>[43]</sup> Problems in the CO<sub>2</sub> canister resulted in rebreathing and hypercarbia,<sup>[44,45]</sup> significant leak and difficulty in ventilation,<sup>[46-50]</sup> and obstruction to ventilation.<sup>[51]</sup> Although use of circle system, CO<sub>2</sub> absorbents and low-flow anaesthesia are beneficial in economy of gases, they have inadvertently contributed to ventilator problem due to water condensation and production of dangerous substances such as compound A.<sup>[52,53]</sup>

Inability to detect minor leaks in the machine or breathing circuit is observed with modern machines having minimum mandatory oxygen flow, while testing for leak with Bain's circuit was also found to be difficult with modern Aestiva 5<sup>®</sup> anaesthetic machine.<sup>[54,55]</sup> Designing the ratio valve of the minimum mandatory O<sub>2</sub> flow system to vent to the atmosphere on switching the master switch off resulted in false positive for leaks when the universal leak test was applied in Cavendish anaesthesia machines.<sup>[56]</sup> Intraoperative replacement of reservoir bag by new latex-free bag contributed to difficulty in ventilation due to the presence of a large hole in the newly replaced bag.<sup>[57]</sup> Twisting of the bag around its own neck resulted in a tight bag scenario.<sup>[58]</sup> Increased depth of corrugations minimises circuit kinking;<sup>[59]</sup> however, this can result in leaks as damage to corrugated tubing is not easily identifiable on inspection.<sup>[60]</sup> Disposable breathing

circuits and airway equipment minimise infective risks. However, transparent packaging of the breathing circuit accidentally caught in the straight connector of the breathing circuit was responsible for obstruction to ventilation.<sup>[61]</sup> Scavenging system reduces theatre pollution. However, scavenging equipment has contributed to obstruction to flow of gases.<sup>[62-65]</sup>

Despite significant improvements in the design and safety aspects of anaesthesia machine and its components, some of the older and well-known problems continue to exist such as water vapour condensation inside the machine components, bobbins of the flow meters may get stuck to the inner wall of the flow meter due to dirt and static electricity, possibility of leak from the selectatec system of vapourisers in the event of accidental removal of O-ring during the process of mounting or dismounting of the vapourisers, etc.

## SCAVENGING

Long term exposure to trace anaesthetic gases released into the operating room during the conduct of general anaesthesia may be harmful to health-care personnel involved. There is evidence to show a higher rate of spontaneous abortion in women. Further, this could contribute to an increase in the incidence of infertility in the operating room personnel as well as higher chances of having children with congenital anomalies. Anaesthesiologists appear to have a predisposition to the development of various organ system disorders that may be attributable to long-term exposure to trace anaesthetic gases.<sup>[66]</sup> Therefore, the need for scavenging cannot be overemphasised.

Scavenging is the process of collection of exhaled gases from the anaesthetic equipment and disposal of the same to an appropriately designated place away from the operating room. Scavenging system is designed to minimise theatre pollution. Basic components necessary for efficient scavenging include a system to recover the exhaled gases from anaesthetic equipment, tubing to transfer these to a receiving reservoir and a system to dispose these gases away from the operating room. Ideal scavenging system components should be free from leaks and kinks, have a colour and diameter different from that of the conventional breathing circuitry to prevent misconnections.<sup>[66,67]</sup>

Scavenging apparatus includes a system to recover exhaled gases from the anaesthetic equipment that should not cause resistance to exhalation and fit

correctly over the exhaust port of the anaesthesia ventilator and the APL valve of the breathing circuits. Most receiving and reservoir systems in anaesthesia use are open types where the gases are collected into a reservoir and are transferred to the disposal system through a suction port. These also minimise transmission of pressure fluctuations in the scavenging system to anaesthetic circuitry. Open reservoir systems communicate to atmosphere through one or more ports. Closed systems communicate to atmosphere through valves and do not require a reservoir if active disposal system is used. The disposal apparatus can function either actively or passively. Patient's exhalation effort or positive pressure generated from manual ventilation or ventilator helps push the gases to their exit destination in the passive system. This can also be reached with the help of air circulating systems. Although activated charcoal canisters can be used to passively adsorb the volatile anaesthetic gases, they do not adsorb N<sub>2</sub>O and require frequent refilling. Catalytic decomposition of N<sub>2</sub>O to nitrogen and O<sub>2</sub> can be considered to minimise the harmful effects of N<sub>2</sub>O. In the active system, a working fan or vacuum pump draw the gases to their exit destination. Vacuum disposal creates the requirement for multiple vacuum ports (surgical, anaesthetic and scavenging) in the operating room and care to prevent negative pressures affecting the breathing system. Fans are less efficient than vacuum and require wide bore tubing. Open receiving and reservoir systems require active gas disposal system.<sup>[66,67]</sup>

Other ways of minimising atmospheric pollution include gas delivery equipment with negligible leaks, low flow anaesthesia, minimal leak around the airway equipment (facemask, tracheal tube, laryngeal mask airway, etc.), ≥15 air changes per hour and total intravenous anaesthesia.<sup>[66,67]</sup>

## SUMMARY

The review highlights the fact that problems can occur despite the incorporation of several safety aspects to anaesthesia machine. Human factors have contributed to greater complications than machine faults. Therefore, better understanding of the basics of anaesthesia machine and checking each component of the machine for proper functioning prior to use is essential to minimise these hazards. Despite advanced technology, a remote but life-threatening possibility of intraoperative machine malfunction exists. A self-inflating bag appropriate for the patient's age

and alternate O<sub>2</sub> source should be present as rescue measures in the event of machine malfunction.

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## Conference Calendar Details

### Name of the conference: ISAAPCON - 2013

**Date:** 25<sup>th</sup> to 27<sup>th</sup> October 2013

**Venue:** Mamatha Medical College, Khammam

**Organising Secretary:** Dr. Badam Kishan Rao

**Contact:** +91 98661 81161

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### Name of the conference: 37<sup>th</sup> Annual State Conference - Kerala

**Date:** 25<sup>th</sup> to 27<sup>th</sup> October 2013

**Venue:** Shifta Convention Centre, Malappuram, Kerala, India

**Organising Secretary:** Dr. Mohamed Abdul Nazar

**Contact:** +91 09400 627481

**E-mail:** ekmanazar@gmail.com

### Name of the conference: BJSAC 2013

**Date:** 26<sup>th</sup> and 27<sup>th</sup> October 2013

**Venue:** Katihar Medical College

**Organising Secretary:** Dr. Ashutosh Kumar Jha

**Contact:** +91 94312 28657

**E-mail:** bjsac2013@gmail.com

### Name of the conference: ICA CON - 2013

**Date:** 23<sup>rd</sup> and 24<sup>th</sup> November 2013

**Venue:** Bhopal Memorial Hospital & Research Centre

**Organising Secretary:** Dr. Anurag Yadava

**Contact:** +91 94250 12102

**E-mail:** icacon2013@gmail.com

### Name of the conference: 61<sup>st</sup> Annual National Conference of the Indian Society of Anaesthesiologists, ISACON 2013

**Date:** 26<sup>th</sup> to 29<sup>th</sup> December 2013

**Venue:** Gauhati Medical College, Assam, India

**Organising Secretary:** Dr. Rajib Kr. Bhattacharyya

**Contact:** +91 94350 30338

**E-mail:** isacon2013@gmail.com

**Website:** www.isacon2013.com

### Name of the conference: ISA Sponsored CME – Katihar City Branch

**Date:** 26<sup>th</sup> October 2013

**Venue:** Katihar Medical College

**Organising Secretary:** Dr. Ashutosh Kumar Jha

**Contact:** +91 94312 28657

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### Name of the conference: ISA Sponsored CME – Tumkur City Branch

**Date:** 24<sup>th</sup> November 2013

**Venue:** Tumkur

**Organising Secretary:** Dr. C V Swamy

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### Name of the conference: ISA sponsored CME – Rajahmundry City Branch

**Date:** 1<sup>st</sup> December 2013

**Venue:** Rajahmundry

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