Instructor Manual: Pulse Oximetry
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Preface

This training manual has been written by the Lifebox team based on experience gained from teaching both physician and non-physician anaesthesia providers in many parts of the world. It is intended as a guide for those who wish to introduce the Lifebox oximeter and the WHO Surgical Safety Checklist to operating rooms where they are currently not in place.

Lifebox training is meant to be interactive with most of the teaching done in small groups. This manual suggests an outline for the day and includes detailed instructions on how to run the various types of sessions. This is a work in progress and we would be pleased to receive any feedback on how to improve this course, and thus achieve the aims of Lifebox Foundation: Saving lives through safer surgery.

Website: www.lifebox.org
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Introduction to the Lifebox oximetry training packet

The Lifebox Training Packet contains all of the materials needed to run a Lifebox Oximetry Training Workshop. The course contains 5 individual modules that can be used together as a one-day workshop or can be delivered individually depending on the needs of the intended audience. For participants who have little experience with pulse oximetry, it is recommended that all of the modules be delivered in order either as a one-day workshop or integrated into another training programme.

If the intended audience has extensive experience with pulse oximetry, Module 2: Practical Guide to using the Lifebox Pulse Oximeter should be taught as a minimum to familiarise participants with specifics regarding the use and proper care of the Lifebox pulse oximeter. If time permits, experienced anaesthesia providers will still benefit from participation in the complete workshop as it may have been some time since they reviewed the basic physiology of oxygen transport.

Course contents

Module 1: Physiology of oxygen transport
- Plenary (large group format) – all workshop participants should attend together
- Delivered in lecture format. PowerPoint and notes provided
- Serves as a review for physicians or those experienced with pulse oximetry but may be new information for non-physicians

Modules 2-4
- Intended to be delivered consecutively in small group format (8-10 participants).
- Instructors may be assigned to a specific small group or they may rotate between groups to provide some diversity in teaching styles. To save time it is recommended that workshop participants remain in one classroom and, if desired, faculty rotate between modules.

Module 2: Practical guide to using the Lifebox pulse oximeter
- Using the manual as a guide, this module is designed to be a hands-on workshop to familiarise participants with specifics regarding the use and proper care of the Lifebox pulse oximeter.

Module 3: The Hypoxia Action Plan and Module 4: Clinical scenarios
- Modules 3 and 4 can be run separately or together in a longer session.
- The instructor should use the information in the manual and the laminate to introduce the hypoxia action plan.
- Clinical scenarios are provided in module 4 to allow participants to practice applying the algorithm. Instructors are also encouraged to use local scenarios.

Module 5: The WHO Surgical Safety Checklist
- Plenary (large group format) – all workshop participants should attend together to introduce the WHO Surgical Safety Checklist.
- In addition to anaesthesia providers, it is suitable for surgeons and nurses to attend.
- Delivered in lecture format; however, group participation is encouraged
- PowerPoint and notes are provided.
The educational package includes

Instructor manual
- Notes on how to teach
- Proposed schedule
- All of the individual modules in slide/note format with suggested key teaching points

Participant manual
- All of the individual modules in slide/note format with key points emphasized
- PowerPoints with teaching notes for Modules 1 and 5
- WHO Manual on Pulse Oximetry
  (This is considered the textbook for the course and a copy should be provided to each participant as a resource.)

Pre/Post workshop quiz
- Tests participant understanding of the physiology of oxygen transport as well as providing some clinical scenarios to test the use of the hypoxia action plan. The same quiz is used both pre- and post-training.

Laminates
- Large legal size (A4) copy of the WHO Surgical Safety Checklist on one side with the Hypoxia Action Plan (HAP) to be printed on the other.

Workshop attendance form

Lifebox pulse oximetry distribution form

Lifebox workshop training certificates

Participant and instructor feedback forms

Checklist for running a Lifebox workshop

Pre-course checklist
- Discuss training workshop with local hosts.
- Confirm Lifebox pulse oximeters have been received and plan distribution strategy with local hosts.
- Confirm with ministry of health that anaesthesia providers can attend the workshop.
- Consider funding required to run workshop:
  - Transport, accommodation for participants
  - Catering
  - Room hire
  - Printing
- Draw up guest list of officials to invite to opening and closing ceremonies (e.g. health ministers, hospital directors)
- Think about which local media to invite to workshop.
- Determine number of workshop instructors needed and identify potential instructors. Number of instructors needed depends on number of participants. Small group workshops should be limited to 8-10 participants. For example, if 32 participants you will need 4 instructors.
- Identify workshop participants
  - Mixture of anaesthesia providers (physician vs. non-physician), surgeons, others?
- Identify site for workshop.
  Facilities needed:
  - One large room for 2 plenary sessions that can accommodate all participants and faculty
  - Breakout rooms for small group sessions. Number dependent on number of participants
  - Flipcharts/whiteboards in each breakout room
- Organise catering
  - Morning tea/coffee
  - Lunch
  - Afternoon tea/coffee
Create timetable and allocate instructors. Distribute materials to faculty members prior to course so they have time to familiarise themselves with course material.

Arrange printing and laminates
- Instructor and participant manuals
- WHO Manual on Pulse Oximetry
- Training Certificates (edited with relevant details and colour printed)
- Timetable
- Attendance form
- Pre/post course test (2 copies per participant)
- Participant feedback form
- Instructor feedback form
- Laminates (colour):
  - Hypoxia Action Plan
  - WHO Surgical Safety Checklist

Organize equipment for workshop
- Laptop and projector (one needed for plenary session)
- Whiteboard or Flip charts (each breakout room)
- Whiteboard/Flip Chart markers
- Name badges
- Paper, pens

Send out course reminders

Prepare packets for participants
- Participant Manual
- WHO Manual on Pulse Oximetry
- Laminate (WHO Surgical Safety Checklist and Hypoxia Action Plan)
- Pen
- Name tag

Proposed workshop schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>Registration, organisation of groups</td>
</tr>
<tr>
<td>08:30</td>
<td>Welcome and introductions</td>
</tr>
<tr>
<td></td>
<td>Objectives and principles of the course</td>
</tr>
<tr>
<td>09:00</td>
<td>Pre-test MCQ</td>
</tr>
<tr>
<td>09:30</td>
<td>Module 1: Plenary: The physiology of oxygen transport (30 minutes)</td>
</tr>
<tr>
<td>10:00</td>
<td>Break</td>
</tr>
<tr>
<td>10:30</td>
<td>Module 2: Workshop: Practical guide to using the Lifebox oximeter (60 minutes)</td>
</tr>
<tr>
<td>11:30</td>
<td>Modules 3 and 4: Workshop: Introduction to Hypoxia action plan and</td>
</tr>
<tr>
<td></td>
<td>Clinical Scenarios (90 minutes)</td>
</tr>
<tr>
<td>13:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:00</td>
<td>Module 5: Plenary: WHO Surgical Safety Checklist (60 minutes)</td>
</tr>
<tr>
<td>15:00</td>
<td>Post-test MCQ; Course Evaluation</td>
</tr>
<tr>
<td>15:30</td>
<td>Review of MCQ answers</td>
</tr>
<tr>
<td>16:00</td>
<td>Presentation of diplomas; group photo</td>
</tr>
<tr>
<td>16:30</td>
<td>Faculty meeting</td>
</tr>
</tbody>
</table>

Day of course checklist
- Confirm equipment above is available and working
- Confirm catering
- Organise registration
- Organise distribution of Lifebox pulse oximeters
- Distribute Lifebox training certificates at end of course

Post-course checklist
- Collect feedback forms and pre/post-course tests
- Analyze feedback and tests
- Write Lifebox Workshop report
- Start planning devices follow up
- Start planning next Lifebox Workshop!
Lifebox workshop learning objectives

At the conclusion of this workshop the participants should be able to:

1. Have a basic understanding of the physiology of oxygen transport
2. Understand how to use a Lifebox pulse oximeter
3. Be familiar with using the Hypoxia Action Plan for managing a falling SpO₂
4. Have a basic familiarity with the Surgical Safety Checklist

How to be a good instructor

Being a facilitator or instructor is about making sure that those you are teaching learn what is intended. Prepare well. Think about how your sessions went and try to improve your abilities as a facilitator.

You are seen as a professional and clinical role model for the participants in these courses. Use your clinical experience and insights during the workshops to help them learn. Many participants will never have been to a course such as this one and may be unfamiliar with this type of small group teaching.

Try to stay on time. Pay attention to how the learners participate in the sessions. Join other facilitators’ sessions as much as possible. Take time to think about how you will run your small group workshop.

Just as the learners do, you too require support and this will come from more experienced course instructors. The course faculty is led by a course director. We recommend a faculty meeting is held before and after the course to ensure the smooth running of the workshop. Your feedback will also be very useful to improve the course for the future.

Workshop equipment requirements

For plenary:

1. Laptop
2. Data projector
3. Screen or suitable wall

For small group sessions:

1. Chalkboard with chalk and eraser, whiteboard and pens or flipchart and pens
2. Lifebox pulse oximeters for Module 2: Practical Guide for using the Lifebox pulse oximeter
3. Laminates of Hypoxia Algorithm for Modules 3 and 4: hypoxia and clinical scenario sessions
Principles of adult learning

To be able to teach effectively you need to understand something of the principles of adult learning.

Adults are generally in a learning situation because they want to be. Children are in a learning situation because they have to be.

If adults do not want to be in the learning situation they will not engage:

• Adults must enjoy what they are doing: they do not enjoy threats, humiliation or fear
• Adults must understand what they are doing
• Adults must see a reason for what they are doing and their reasons are very varied
• Learning must be interesting, relevant, applicable, achievable and adult learners must be able to say they have achieved something
• Adults must be able to see how what they learn can be applied
• Adults learn in many different ways so different methods of teaching must be used.

Adult learning methods include:

• Listening
• Watching
• Reading
• Talking
• Doing
• Interacting

How to teach

Any teaching activity should have a defined beginning, middle, and end.

The beginning is about emphasising the importance of the piece of teaching and stating which important points will be covered, explaining how this will be done and setting the mood. The end is about emphasising the main points that have been covered.

This model applies to all teaching methods such as lectures, scenarios, skills, workshops and demonstrations.

Giving a lecture

The Lifebox oximeter course has two general lectures:

• Physiology of Oxygen Transport
• The WHO Surgical Safety Checklist

You do not need to write the lectures: they are already written, but you do need to practise them. Spend some time prior to the course doing this. You must be very familiar with the lecture and also with the subject, as you might get asked questions about things which have not been covered in the lecture.
Make sure your lecture is loaded on to the laptop and that it runs and projects well.

• Begin by greeting the audience and introduce yourself. Then start with the Aims. These are described on a slide at the beginning of every lecture. If necessary, add to this the arrangements for questions such as ‘I will take questions at the end’.

• Do not read from the slides. Know them well and say in a natural way what the message on the slides is. You can add in comments or examples if you have time, although this will mostly be covered in the small group sessions.

• Stand to the right of the screen and halfway between the screen and the audience, making sure that you can reach the laptop to change the slides.

• Hold your head up and speak as if you are talking to somebody at the back of the room.

• Please note that, for many people attending these courses, English is not their first language. Speak clearly; avoid colloquial language, slang, jokes, and so on. Use simple English.

• You can ask questions of the group or of individuals. Be careful not to ‘humiliate’ participants. Be aware that some delegates have many years of experience (although their practice may be different from yours). When the answer comes, repeat it so that everyone in the audience hears the answer.

• When you take questions, make sure that the audience has heard the question and, if necessary, repeat it.

• If a question is not easily answered in the group, you can ask for the help of the facilitators or ask if anyone has any ideas or relevant experience. If the question develops into a discussion, keep the discussion brief by saying that there is time to elaborate in the small groups and during break times.

Small group sessions

The small group or breakout sessions take the form of workshops, discussions, and scenario teaching.

The large group should be divided into several smaller groups ideally of 8-10 students with 1-2 faculty members to run the session. The faculty and students can be paired for all of the sessions or the faculty can rotate among the groups. Having the faculty rotate is less disruptive and takes less time than having all of the students rotate rooms.

Each workshop has a set of slides to guide you through the session. These are not intended to be presented as a lecture but to be followed in a step-by-step way so as to cover everything that is necessary in the session. Involve the participants in discussions and questions. Remember these workshops are meant to be lively, hands-on and interactive.
Leading a discussion

There are two sorts of discussion: open and closed. An open discussion is where comments are made from individual to individual without going through the discussion leader. A closed discussion is one where the leader is at the centre of the discussion and comments are all passed through the leader. A closed discussion allows the leader to control the direction and content of the discussion. It is recommended for more junior (or new) learners.

Demonstrating a skill

A good method for teaching a skill is to use the ‘four part’ process. This involves:

- Demonstrating the skill
- Demonstrating and describing the skill
- Demonstrating the skill and asking one of the participants to describe it
- Getting each learner to actually do it and describe what he or she is doing

Depending on the situation, there may not be an oximeter for every participant in the workshop. Make sure that everyone gets an opportunity to try the oximeter and to manipulate all the buttons. Ask if there are any questions and then summarise by emphasising the main points. If there is insufficient time, or there are individuals who have not had sufficient time, you can suggest that learners come back to the station at the break times.

Tips for presentation of clinical cases

Clinical cases correspond to real or fictitious situations and their purpose is to help participants understand the clinical situation and to support the patient to improve the situation.

The use of clinical cases for teaching is important because they allow the active participation of students, and they are patient-centered. They help to illustrate basic oximetry, the use of decision-making algorithms, and the importance of teamwork. Clinical cases are designed to introduce participants to the basic principles of the use of oximeters and problem solving through the use of resuscitation algorithms (ABCDE). If you plan to encourage your students to use a Logbook, the clinical scenarios can be used to illustrate the use of a logbook and to practice case entry.

Case selection and preparation

It is important to verify that clinical cases are adapted to the level of knowledge of the participants. It is important to be familiar with their level of training, the type of anaesthesia being used and the types of surgical operations performed. These clinical cases can be adapted from one hospital to another and from one country to another.

The clinical scenarios are provided as a bank of potential cases to be used during the training. Instructors are free to adapt them to the needs and knowledge of their students. It is recommended that instructors prepare appropriate clinical cases relevant to the country where they will be teaching.

It is not essential to use all clinical cases at the workshop. Instructors are encouraged to choose scenarios that best illustrate the ABCDE hypoxia algorithm, remembering that airway management difficulties are the main cause of desaturation.

It is recommended that instructors pay attention to the arrangement of the participants’ chairs during the small group sessions. This should not be a formal course and placing the chairs in a circle or semi-circle will help to promote active student participation.
Format of Teaching

The simplest way is to present the slide of the scenario to the group and to discuss clinical management by participants. Instructors trained in simulation workshops can use more sophisticated forms of teaching with role-play. A demonstration pulse oximeter can be useful if available.

The instructor will introduce the clinical case and encourage participants to take charge of the management of the patient as if it were a real situation in the operating room. It is important that participants understand the exercise and the role of the instructor. It should be explained to them that the instructor will only speak to introduce the clinical scenario and then later when guiding the discussion. Students should be encouraged to use the resuscitation algorithm ABCDE in the patient’s care. It is important that students identify and address clinical problems correctly before moving on to the following clinical case. The clinical cases provided have some “Discussion Points” noted. These points include actual or potential causes that can lead to desaturation.

Remember, the objectives of the workshop are how to properly use the oximeter, recognition and treatment of hypoxia rather than discussion of the choice of anesthetic technique. Do not forget to allow time for discussion after each clinical case. The presentation and discussion of a clinical case may require 30 minutes, as some of the clinical cases are more complicated and detailed than others.

At the end of each discussion, ask participants if they still have any questions and make sure to highlight the important points of each clinical situation in the context of the ABCDE algorithm.

Feedback

Although this course is not a pass/fail course, feedback can be useful. It must be given sensitively.

A useful method is to ask the participant how they think that they performed, encouraging them to highlight the positives and then consider points for improvement. If the facilitator chooses not to ask the participant but just to give feedback directly, he or she should also give positive points first and then points for improvement.
Module 1
The Physiology of Oxygen Transport

Aims

• To describe oxygen transport from the air to the cells in the body.
• To explain the importance of haemoglobin (Hb) in oxygen delivery.
• To demonstrate a normal oxygen saturation curve.
• To introduce the pulse oximeter and explain what it measures.

Notes

This is a lecture on the physiology of oxygen transport.

• This concept can be difficult so we will break it down into its component parts so that it is easier to understand.

1.1

1.2

There are 6 steps:

1. $O_2$ breathed from air or anaesthesia circuit into lungs.
2. $O_2$ passes from alveoli in lungs to blood, which is known as “alveolar gas exchange.”
3. The blood contains haemoglobin, which carries oxygen. Blood must contain enough haemoglobin to carry $O_2$ to tissues.
4. Heart pumps blood to the tissues to meet patient’s $O_2$ requirements. This is called cardiac output.
5. Volume of blood in circulation must be adequate to distribute oxygenated blood to tissues.
6. Cells burn the $O_2$ and create carbon dioxide, which is returned to the lungs in venous blood and excreted in the exhaled gas.

All cells need $O_2$. It is the essential fuel that allows all cells to stay alive. How does the $O_2$ in the air we breathe get to the cells?
Air breath we breathe is a mixture of several gases (nitrogen, oxygen, carbon dioxide).

- Each of these gases exerts its own individual independent pressure within the total mixture of gases, which make up atmospheric pressure.
- The pressure at sea level is much higher than on top of a high mountain.

### Transport of Oxygen to blood

**Notes**

- Lungs allow us to breathe in air containing $O_2$.
- Assuming we are at sea level, the $PO_2 = 100\ mm\ Hg$.
- Lung air sacs come into contact with red blood cells (RBC) flowing through the capillaries.
- $O_2$ in the air dissolves in the blood:
  - 98% is taken up by RBCs and transported by the haemaglobin in the blood.
  - 2% of $O_2$ remains dissolved in blood why you get short of breath on top of mountain.
**The red blood cell**

- RBC is especially well suited to transport oxygen; contains a special oxygen binding protein called haemoglobin (Hb).
- Each molecule of Hb contained in RBCs can bind 4 molecules of oxygen.
- $O_2$ saturation = % of Hb carrying oxygen.

**Normal Haemoglobin Saturation**

- The venous blood in the body is only 75% saturated.
- Venous blood is transported to lungs where it comes into contact with $O_2$.
- In normal healthy individuals, the arterial blood in the lungs 95-100% saturated.
- This is the value that is measured by a pulse oximeter.

**Notes**

- 100% saturated = all haemoglobin molecules in blood carrying oxygen to maximal capacity (4 molecules of oxygen).
- 75% saturated = 3 of the 4 Hb molecules of Hb in blood are carrying oxygen (3 molecules of oxygen).

**Oxygen Dissociation Curve**

- 100% saturated = all haemoglobin molecules in blood carrying oxygen to maximal capacity (4 molecules of oxygen).
- 75% saturated = 3 of the 4 Hb molecules of Hb in blood are carrying oxygen (3 molecules of oxygen).

**Notes**

- This is the normal oxygen dissociation curve. It measures the relationship between the partial pressure of oxygen in the blood and the oxygen saturation.
- What do you notice about the shape of this curve?
- It is a very distinctive S shaped curve.
Oxygen Dissociation Curve

Notes
- $O_2$ dissociation is like a cliff. The little man moves along the top part of the curve easily because it is quite flat.
- As long as the partial pressure of $O_2$ is high enough ($pO_2 \geq 60$ mm Hg or $8kPa$), the $O_2$ saturation remains $>90\%$ because the curve is flat and the patient remains well oxygenated.
- If the partial pressure of $O_2$ starts to fall (<60 mm Hg or $8kPa$), then $O_2$ saturation falls very quickly because the curve gets very steep. Notice that the little man falls down the slope. The patient quickly becomes hypoxic.

Hypoxia

Notes
- Shortage of $O_2$ in blood and tissues
- The tissues lose the BRIGHT RED appearance of being well oxygenated
- The tissues become DARK RED or look BLUE and explain what it measures

Clinical Detection of Hypoxia - Cyanosis

Notes
- All tissues in the body depend on oxygen for survival.
- The brain is damaged very quickly if the supply of oxygen to the tissues is interrupted.
- Hypoxic blood looks like venous blood and is dark red or blue.

Notes
- Clinical detection of cyanosis can be difficult especially in dark skinned people.
- Cyanosis is a very late sign of hypoxia.
- Can be difficult to clinically detect
  - darker skinned people
  - anaemic patients
Pulse Oximeter

How does an Oximeter work?

Notes

- What is a pulse oximeter?
- It is a device that measures "O₂ saturation" by measuring saturation of Hb in arterial blood.

Monitor
Microprocessor, Battery and display.

Probe
senses the pulse.

Notes

- The patient must have a pulse for the probe to detect a signal.
- The pulse wave must be displayed on the monitor for the reading to be reliable.

Oxygen Saturation Goal during Anaesthesia

Notes

- ALWAYS ≥ 95% for adults and children
- If the O₂ saturation < 90%, the patient is becoming hypoxic
- INTERVENE EARLY!!!!

- Note the bright red light coming from one side of the probe
- What is this red light for?
  1. All pulse oximeter probes have light emitting diodes (LEDs).
  2. They produce light with two different wavelengths
  3. Some of this light goes through the tissue.
  4. The light detector on other side detects the amount of light transferred through tissues.
  5. The oximeter can then determine the oxygen saturation in the peripheral blood.
What is the best way to detect Hypoxia?

Notes

- The oximeter measures the O₂ saturation in the blood.
- The pulse oximeter provides an early warning sign that works very early, faster than a person.
- The pulse oximeter is the best way to detect hypoxia - patient must have a pulse (point to it) for probe to pick up a signal:
  1. Pulse wave must be displayed for reading to be reliable
  2. Always have volume on (PLAY SOUND!!!)
  3. As soon as the SpO₂ changes audible tone changes; NEVER TURN IT OFF
  4. Allows anaesthetist to concentrate on looking after patient.
- Pulse oximeters have made anaesthesia much safer.
- Remember... the oximeter only works if it can detect a pulse.

Summary

- O₂ from the air we breathe is an essential fuel for the cells in our body
- RBC in our blood contain a special oxygen binding protein called haemoglobin
- O₂ saturation = % of haemoglobin carrying O₂ and is the value measured by a pulse oximeter
- Hypoxia is a shortage of O₂ in the blood
- A pulse oximeter is the best way to detect hypoxia
Module 2

Practical Guide: Using the Lifebox Pulse Oximeter

2.1

Aims

- To go over what comes in the box with your Lifebox pulse oximeter
- To demonstrate proper care for your Lifebox pulse oximeter
- To demonstrate how to use a Lifebox pulse oximeter to measure O₂ saturation

2.2

Notes

Contents of box:
- Oximeter in yellow protective case
- Adult probe
- Paediatric probe
- Rechargeable battery
- Power cord with 3 different plugs. Choose correct one for location.
- Paperwork: Quick guide, guarantee with Lifebox contact information, letter from Lifebox.

2.3

The Lifebox Pulse Oximeter

Notes

1. When the Lifebox is fully charged, remove the oximeter from the mains power.
2. If not removed from the main power when fully charged, there is a risk of overheating of the device and other damage may occur.

2.4

Caring for your Oximeter

Lifebox power supply

Notes

- Mains Power
- Standard AA batteries
- Rechargeable Lithium Battery
Caring for your Oximeter

Lifebox rechargeable battery

2.5

- Arrives ½ charged
  1. use until fully discharged
  2. then recharge fully (4 hours) uninterrupted
- Thereafter use until recharge needed
- A fully charged battery should run for 12-16 hours between charges

Notes

- Remove yellow cover to reach battery compartment
- Insert rechargeable battery
- Replace battery cover and yellow protective cover

- Review how and when to recharge the battery
- If using AA batteries, do not plug the oximeter into the mains power
- There is a risk of overheating of the device and other damage may occur

Caring for your Oximeter

Keep battery charged

2.6

- In case of power failure, fully charged battery should last 12-16 hours.
- When the Lifebox pulse oximeter is fully charged, it should be removed from the mains power.
- If not removed from the mains power when fully charged, there is a risk of overheating the device and damage may occur.

Caring for your Oximeter

If the “special” Lifebox rechargeable battery no longer works!

2.7

- REMOVE BATTERY as risk of damage to device*

Options:
- Use normal AA batteries
- Use rechargeable AA batteries
- Plug device directly into Mains
  - NO battery should be in the device.

Notes

- Arrives ½ charged
  1. use until fully discharged
  2. then recharge fully (4 hours) uninterrupted
- Thereafter use until recharge needed
- A fully charged battery should run for 12-16 hours between charges

- Review how and when to recharge the battery
- If using AA batteries, do not plug the oximeter into the mains power
- There is a risk of overheating of the device and other damage may occur

* REMOVE BATTERY as risk of damage to device
Caring for your Oximeter
Connecting / Disconnecting probe

- Insert probe connector correctly to avoid damage. Lead only inserts one way.
- Check shape before inserting.
- When disconnecting and connecting probe, grip end firmly and not cable. If cable is pulled, small wires inside will break.

Notes
- Practise connecting and disconnecting the probe to the oximeter.
- Do not pull on the cable.

Probes are FRAGILE and need to be handled with care.

Notes
- 3 types of probes: universal, paediatric and neonatal.
- Universal and paediatric probes are supplied with your Lifebox pulse oximeter.
- Practise how to correctly place the probe on finger.
- Probes are fragile and need to be handled with care.

Caring for your Oximeter
Clean probe between patients

Notes
- Gently clean between patients with damp cloth or alcohol swab.
Caring for your Oximeter

When not in use

- Keep in safe place
- Wrap the cable and sensor with care
- Don’t forget to recharge if needed

Notes

- If the cable is wrapped too tightly, it may be damaged.
- If the cord hangs down, it may get broken.

Using the Lifebox Pulse Oximeter

Notes

- Practice using all the function buttons of the oximeter

The Lifebox Pulse Oximeter

Adjusting alarm setting

Notes

- It is important to know how to adjust the pulse oximeter depending on the age of the patient: adult, paediatric, or neonatal.
- Practice changing the various settings such as for oxygen and pulse rate.

How does a pulse Oximeter work?

Notes

- Pulse oximetry uses a light to measure oxygen saturation.
- The pulse oximeter probe consists of two parts: a light source (which is a light emitting diode) and a light detector.
- Light from the light source will penetrate tissue placed in the probe.
- The light detector will detect that light.
Review
Is the Oximeter functioning?

Notes

1. Place a finger in the probe and look at HR and O₂ saturation on Lifebox screen.
2. Use the diagram above to observe that:
   a. If a finger is placed in the probe, the light source sends out waves of light. Some light is absorbed by the tissue in the finger and the remainder penetrates through the tissue to the light detector.
   b. The amount of light absorbed by the tissues varies with the amount of oxyhemoglobin and deoxyhemoglobin in the pulsatile blood.
   c. The light detector then detects both a pulse and the light that is not absorbed that is transmitted through the tissue.
   d. The microprocessor in the pulse oximeter calculates the value for oxygen saturation.

Notes

• Put the probe on a finger and look specifically at the tracing.
• What does a 'good' tracing look like?

Review
How to check if the Oximeter is working

Notes

• Here is a diagram of a poor tracing.
• Is the oximeter working properly?
• How can you check?
Review

To check probe

2.18

Well positioned probe

2.19

Notes

- Place probe on your own finger
- Look at the waveform
- Look for the oxygen saturation and heart rate
- This is a well-positioned probe.
- Not too tight
  - Does not constrict circulation
- Not too loose
  - Does not fall off or let outside light in

Review

Poorly positioned probe

2.20

Notes

- This is a poorly positioned probe.
- Too small for toe
  - Forcing on too large a digit can cause damage to probe
  - Probe will not function

Causes of inaccurate Pulse Oximeter readings

Nail polish or dye on the digits

2.21

Notes

What might cause inaccurate pulse oximeter readings?

- Absorbs the light
- Interferes with detection of haemoglobin
- May detect a pulse but unable to measure \( \text{SpO}_2 \)

Solutions

- Place probe on sideways
- Place probe on toe
Causes of inaccurate Pulse Oximeter readings

Bright lights

- Operating room lights can interfere with light detector on probe
- Avoid shining bright light directly on the probe!

Movement

- \( \text{SpO}_2 \) is 95% and pulse 84 bpm
- Pulse oximeter tracing shows good waveform with regular pulse

Notes

- Look at waveform to make sure tracing is good.
- Good tracing = accurate reading.

Low perfusion

- Scale of waveform is indicator of patient perfusion
- Peripheral vasoconstriction can lead to low perfusion
  - cold patient
  - hypovolemia

Notes

- To function properly oximeters need good perfusion to the fingers.
- The Lifebox pulse oximeter displays the quality of this perfusion by a waveform.
- The scale (height of the waveform) is a good indicator of the perfusion.
- Poor perfusion can lead to incorrect readings.
- There is an alarm to let you know the patient has low perfusion.
- Note the fast heart rate and the alarm that says “low perfusion.”
- Perhaps the patient is hypovolemic?

Shivering

- Shivering is a common problem in recovery, but not common in theatre.
- Patient may be moving or shivering
- Check the patient carefully before deciding the oximeter is not correct.

Notes

- Hold hand steady or
- Wait until the patient has stopped shaking

Alarm!!

- \( \text{SpO}_2 \) 67%
- PR 42
- Pleth 90
- St 95 84
- PR (bpm) 100
- Notes
  - To function properly oximeters need good perfusion to the fingers.
Causes of inaccurate Pulse Oximeter readings
Carbon Monoxide (CO) poisoning

- CO combines with haemoglobin (COHb) and displaces O₂.
- COHb is Bright Red.
- Pulse oximeter misinterprets COHb as oxygenated blood.

Notes
- Smoke inhalation can cause CO poisoning.
- Carbon monoxide competes with O₂ to bind to Hb in blood and actually displaces it.
- CO bound to Hb is bright red and is misread by the pulse oximeter as oxygenated blood.
- This is a dangerous situation for the patient as the oxygen saturation is falsely elevated.

Summary
- The pulse oximeter probe uses a light to measure oxygen saturation.
- A good tracing means the pulse oximeter is working properly.
- Good probe position is essential for a good tracing.
- Proper care of your Lifebox pulse oximeter will ensure it works properly when you need it.

Module 3
Hypoxia Action Plan

Aims
- To present a systematic approach to managing a falling SpO₂ under anaesthesia.

Oxygen Saturation (SpO₂) during anaesthesia

Notes
- What is normal oxygen saturation during anaesthesia?
- Look at the readings on the pulse oximeter in the picture, what is the heart rate and oxygen saturation of this patient?
- Are these values normal or not?
- They are normal as this is the arm of an infant undergoing anaesthesia.
Interpretation of pulse oximetry measurement

<table>
<thead>
<tr>
<th>SpO2 (%)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;94</td>
<td>OK</td>
</tr>
<tr>
<td>90% - 94%</td>
<td>?</td>
</tr>
<tr>
<td>&lt;90</td>
<td>! ACTION</td>
</tr>
</tbody>
</table>

Notes

- Now that you know how to use a pulse oximeter, you need to know how to interpret the values that it gives you.
- If the SpO2 is <95% during or after anaesthesia, you need to be sure to look for a reason why.
- If the SpO2 falls below 90%, it becomes dangerous to the patient as he/she is becoming hypoxic.
- The Lifebox pulse oximeter will alarm and urgent action is needed!

Hypoxia Action Plan: Saturation < 94%

Notes

- The Hypoxia Action Plan provides a systematic approach to the management of hypoxia in the operating room and recovery room.
- Use the plan for the patient whose saturation falls below 95%.
- Make a poster of the Hypoxia Action Plan and place it on the wall of the operating room.
**Hypoxia Action Plan: Immediate action plan**

### Patient Problems

**Airway**
- Use chin lift / jaw thrust if using a mask
- Reposition LMA if necessary
- Check position of tracheal tube
- If in doubt take LMA or tracheal tube out
- Treat laryngospasm if present

**Breathing**
- Check adequate rate
- Check adequate tidal volume
- Check ET CO2
- Listen to both lungs
- Bronchospasm? - consider bronchodilators
- Pneumothorax? - consider chest drain

**Circulation**
- Check pulse
- Check blood pressure
- Check ECG
- Blood loss / dehydration / fluid loss?
- Consider IV fluid replacement

**Drug Effects**
- Opioids
- Volatile agent
- Sedatives
- Muscle relaxant
- High spinal?

### Equipment Problems

**Equipment**
- Check oxygen supply / concentrator / cylinder
- Check for breathing circuit disconnection
- Check for breathing circuit obstruction
- If problem not resolving:
  - Eliminate circuit - use self inflating bag
  - If self inflating bag not available consider:
    - Mouth to mouth / tracheal tube ventilation

**Notes**

**Study the steps of the Hypoxia Action Plan:**
1. If the O2 saturation is <95%, this is HYPOXIA until proven otherwise
2. Take action immediately!
   - Give high flow oxygen
3. Try to solve the problem using the algorithm

---

**Hypoxia Action Plan: Call for help early**

**Is the problem with the patient?**
**Is the problem with the equipment?**
**Call for help if needed**
- Check A B C D E

**HELP**

- **Is the problem with the patient?**
- **Is the problem with the equipment?**
- **Call for help if needed**
- **Check A B C D E**

**Notes**

- Hypoxia can worsen rapidly and needs emergency intervention. Remember the little man on the oxygen dissociation curve.
- Call for HELP EARLY. No one minds coming to help and finding that the problem has been solved
- HELP can include other anaesthetists, a surgeon, nurses, someone else.
The cause of the patient’s drop in oxygen saturation is either due to an underlying patient problem or an equipment problem. This is a critical decision to make. Use the ABCDE approach to systematically try to solve the problem. Start with the patient and then move on to the equipment.

### Hypoxia Action Plan: Solving the problem: patient vs. equipment

#### A: Patient problems

**Airway**
- Use chin lift / jaw thrust if using a mask
- Reposition LMA if necessary
- Check position of tracheal tube
- If in doubt take LMA or tracheal tube out
- Treat laryngospasm if present

**Breathing**
- Check adequate rate
- Check adequate tidal volume
- Check ET CO₂
- Listen to both lungs
- Bronchospasm? - consider bronchodilators
- Pneumothorax? - consider chest drain

**Circulation**
- Check pulse
- Check blood pressure
- Check ECG
- Blood loss / dehydration / fluid loss? Consider IV fluid replacement

**Drug Effects**
- Opioids
- Volatile agent
- Sedatives
- Muscle relaxant
- High spinal?

**Notes**
- A is for AIRWAY.
- This is an action plan for hypoxia.
- Go through the steps listed above which address problems with the airway.

#### B: Patient problems

**Breathing**
- Check adequate rate
- Check adequate tidal volume
- Check ET CO₂
- Listen to both lungs
- Bronchospasm? - consider bronchodilators
- Pneumothorax? - consider chest drain

**Notes**
- B is for BREATHING.
- Go through the steps listed above to assess the patient’s breathing.

**Circulation**
- Check pulse
- Check blood pressure
- Check ECG
- Blood loss / dehydration / fluid loss? Consider IV fluid replacement

**Drug Effects**
- Opioids
- Volatile agent
- Sedatives
- Muscle relaxant
- High spinal?
C: Patient problems

**Circulation**
- Check pulse
- Check blood pressure
- Check ECG
- Blood loss / dehydration / fluid loss?
- Consider IV fluid replacement

**Notes**
- C is for CIRCULATION.
- Go through the steps listed above to assess the patient’s circulation.

**Causes of inadequate circulation**

- Hypovolemia
- Cardiac failure
- Sepsis
- Anaesthesia overdose
- High spinal
- Anaphylaxis
- Arrhythmia
- Hypotension
- Decrease $O_2$ saturation
- Tachycardia
- Bradycardia
- Poor signal on pulse oximeter

D: Patient problems

**Drug Effects**
- Opioids
- Volatile agent
- Sedatives
- Muscle relaxant
- High spinal?

**Notes**
- D is for DRUG effects.
- Many anaesthesia drugs may cause respiratory depression, muscle weakness or paralysis.
- A high spinal may cause respiratory failure.
- All of these drug effects can lead to decreased oxygen saturation.

E: Patient problems

**Equipment**
- Check oxygen supply / concentrator / cylinder
- Check for breathing circuit disconnection
- Check for breathing circuit obstruction

  If problem not resolving:
  Eliminate circuit - use self inflating bag

  If self inflating bag not available consider:
  Mouth to mouth / tracheal tube ventilation

**Notes**
- E is for EQUIPMENT.
- If you can’t find a problem with the patient, start to look at the equipment.
- Go through the steps listed above to evaluate the equipment.
Module 4
Clinical Scenarios

Case 1

A 12-year-old child is scheduled for elective anaesthesia for foot surgery. The patient is ASA1. Anaesthesia is induced with thiopentone followed by halothane in air and oxygen via a facemask. During the induction the patient starts to cough and develops laryngospasm. The SpO₂, which started at 98%, falls to 88% during coughing, and then 74% when laryngospasm starts.

Why has the saturation fallen? What would be the most appropriate actions?

Expected discussion points:

• Give 100% oxygen, assess ABCDE
• A - Is there airway obstruction due to laryngospasm? Apply positive pressure to the reservoir bag, deepen anaesthesia. If the situation does not resolve, a small dose of suxamethonium (0.5mg/kg) should be given.
• B - The breathing improves after resolution of laryngospasm
• C – Assess pulse rate. Bradycardia may occur due to hypoxia or secondary to suxamethonium. Consider atropine after treating hypoxia.
• D – Check that the halothane has not run out. Light anaesthesia can cause laryngospasm.
• E – Check that the anaesthesia equipment is functioning and connected appropriately.

After treating the laryngospasm, the patient improved and the SpO₂ returned to normal.
Case 2

A 56-year-old obese patient is undergoing laparotomy for bowel obstruction. Preoperatively he is reasonably fit and his SpO2 is 95%. After rapid sequence induction and intubation, the patient is ventilated and anaesthesia is maintained using halothane in air with 30% oxygen. Over the next 10 minutes the patient’s SpO2 falls to 85%.

What are the most likely causes and what action would you take?

Expected discussion points:
- Give 100% oxygen, check ABCDE
- A – Check the airway and position of the tracheal tube. Check there is equal air entry to both sides of the chest and that the tube is not kinked. Check that there is no vomit in the mouth to suggest that the patient may have aspirated.
- B – Check that there are no added breath sounds to suggest aspiration, lung collapse or bronchospasm. Give large tidal volumes by hand and listen to the chest. Is ventilation easy?
- C – Assess whether the circulation is normal.
- D – Assess whether the patient is fully relaxed. Check that there are no signs to suggest drug reaction (particularly wheeze + hypotension+ rash, which are signs of anaphylaxis)
- E – Check that the anaesthesia equipment is functioning and connected appropriately.

After ventilating the patient with some large tidal volumes and increasing the inspired oxygen the patient improved. The problem was lung collapse (atelectasis).

Case 3

During a Caesarean section under spinal anaesthesia, a fit 23-year-old primigravida complains of tingling in the fingers and difficulty breathing. The SpO2 falls from 97% to 88%.

What are the likely causes and what action would you take?

Expected discussion points:
- Give 100% oxygen and check ABCDE
- A – Check that the airway is clear.
- B – Assess breathing. A high spinal may paralyse the muscles of respiration. If breathing is inadequate, ventilate the patient and induce anaesthesia and intubate after rapid sequence induction. Ventilate until the block wears off.
- C – Check the blood pressure – hypotension is likely. Treat with left lateral tilt, IV fluids and vasopressors.
- D – Check the height of the block. Look for signs of a very high block – difficulty in breathing, whispering rather than talking, weak arms, poor handgrip and weakness of the shoulders. All indicate that nerves of the diaphragm are becoming blocked. This will make it impossible for the patient to breathe. If the block is not this high, the patient can talk in a normal voice and move their arms normally, but breathing may feel difficult due to paralysis of the intercostal muscles.
- E – Always ensure that equipment for resuscitation and induction of anaesthesia is ready in case this complication occurs.

After giving oxygen, the anaesthetist determined that the block was not too high and the patient settled with reassurance, left lateral tilt and IV fluids. The blood pressure returned to normal. The SpO2 improved with oxygen.

Note – any hypoxia in a pregnant patient is dangerous for the baby.
Case 4

A 7-year-old boy is undergoing an open reduction of a fractured radius and ulna. Anaesthesia is induced with thiopentone and suxamethonium. After intubation you are unable to ventilate the patient. His saturation starts to fall.

What is your management?

Expected discussion points:

- Give 100% oxygen, check ABCDE
- You are unable to ventilate the patient. This could be a patient problem or an equipment problem.
- Replace the breathing circuit with a self-inflating bag to exclude possible equipment problems. Don’t forget to replace the angle piece, as this may be where the obstruction is. If there is no self-inflating bag, breathe down the tracheal tube.
- Investigate possible patient problems, including a problem with the tracheal tube – check ABCDE

The patient is easy to ventilate when the equipment is changed, and the obstruction was due to an obstruction in the breathing system. This case emphasises the importance of excluding an equipment problem prior to assessing the patient using ABCDE.

Case 5

Your colleague asks you to take over an anaesthetic for him, as he has to get away to a family event. The patient is a 19-year-old man who suffered major burns two weeks ago in a house fire. The patient is breathing spontaneously via a laryngeal mask airway and has received fentanyl for analgesia. The breathing mixture is air, oxygen and halothane. The surgery has been going for over an hour. There is an IV with normal saline in the right arm, which also has the blood pressure cuff and a pulse oximeter in place. The left arm and legs and part of the left side of the abdomen are involved in the burn debridement. Things continue for another hour and you notice the pulse rate going up to 110/min and the BP dropping to 80-90 systolic. The pulse oximeter seems to only work intermittently. When it does read, the saturation seems to be steadily decreasing. Your colleague documented the SpO₂ at the start of the case at 97%. It is now reading 92%.

What issues are you thinking about as the case proceeds?

Expected discussion points:

- Give 100% oxygen, check ABCDE
- A – Check the airway - the airway is clear
- B – Give large tidal volume breaths and listen to the chest. The patient may be suffering respiratory depression from halothane, atelectasis from a long procedure or pre-existing lung damage from smoke inhalation.
- C – Check peripheral perfusion. The patient may be suffering volume loss from the burns or due to the debridement procedure.
- D – Consider hypoventilation due to halothane or opioid analgesia.
- E – Check the equipment, including the oximeter. The oximeter may have become displaced as used on the same limb as the blood pressure cuff. The oximeter may not be reading properly as the patient is hypothermic from wide exposure, or hypovolaemic due to the debridement.
- The patient has poor peripheral perfusion due to volume loss, and the oximeter trace shows ‘poor perfusion’. The ventilation is assisted and the patient volume resuscitated with warmed fluids including blood. The oximeter trace improves as the patient is resuscitated.

This case demonstrates how the oximeter is affected by poor perfusion, and can be used as an early warning of poor perfusion.
Case 6

In the recovery room, following a laparotomy under relaxant anaesthesia, a 43-year-old patient is reported to have a $\text{SpO}_2$ of 77% and is making twitchy, jerky movements.

What action would you take, and what are the most likely causes?

Expected discussion points:
• Give 100% oxygen, check ABCDE
• A – Open the airway
• B – Assess breathing. If chest expansion is inadequate, assist with a bag and mask.
• C – Check pulse and make sure that IV access is patent.
• D – Assess muscle power – ask the patient to grip your hand or to lift their head from the pillow. If inadequate reversal suspected, give anticholinesterase/anticholinergic reversal (e.g. neostigmine and atropine).
• E – Check the position of the oximeter probe.

Inadequate reversal of muscle relaxants is a common cause of breathing problems and hypoxia in recovery.

Case 7

A six-month old child is booked for general anaesthesia for an emergency laparotomy. She has been unwell for five days and required large amounts of fluid for resuscitation. Just prior to induction her pulse rate is 130 and $\text{SpO}_2$ is 95% on high flow oxygen. Anaesthesia is induced with thiopentone and suxamethonium. She is intubated with a new size 4.0 tracheal tube. Just after intubation her saturation drops to 80%.

What is your management?

Expected discussion points:
• Give 100% oxygen and check ABCDE
• A – The tracheal tube is suctioned and does not seem blocked. Whilst preparing to listen to the chest, the saturation has fallen to 60%. Capnometry is not available.
• B – Her abdomen is swollen and chest expansion is difficult to assess. You are unable to hear breath sounds. Saturations are now 45% and the heart rate is 60.
• It is not certain that the tracheal tube is in the trachea. Participants should be prompted to return to A to check the position of the tracheal tube.
• A – repeat laryngoscopy shows the tracheal tube is not in the larynx. The $\text{SpO}_2$ falls to 30%, the patient is mask ventilated to raise the saturation and then reintubated.
• B – Chest expansion is now obvious and the saturation quickly returns to 96%.

This scenario highlights the importance of correcting a problem before moving on to the next part of the algorithm.
Case 8

You are giving an anaesthetic to a 75-year-old lady for fixation of a fractured hip. She fell a week ago and has been waiting for surgery since then. She has dementia and cannot give you a proper history. You hear a loud systolic murmur at the right sternal border radiating to the carotid. Air entry at the lung bases is poor and you think you can hear some coarse crackles as both lungs fill. You proceed with a general anaesthetic consisting of fentanyl, thiopentone, and atracurium. Following intubation, you connect the tracheal tube to the ventilator and give oxygen and halothane. Following positioning on the operating table, you notice you cannot get a trace on the pulse oximeter. You check the blood pressure but find it hard to hear the sounds. You try a couple more times but no luck. You feel for a carotid pulse and think you can feel it.

What is your management?

Expected discussion points:
• Give 100% oxygen, check ABCDE
• A – The tracheal tube appears to be correctly positioned.
• B – Listen to the chest. Does she have atelectasis or pneumonia, or both? Has she aspirated?
• C – Does she have heart failure? Aortic stenosis? Is there evidence of hypovolaemia from dehydration?
• D – Is her blood pressure low from thiopentone and/or halothane? What is the treatment for this? (Careful IV fluids, careful use of vasopressors).
• E – Is there a problem with the pulse oximeter? Does it work if the peripheral pulse is absent or weak? Is the patient cold? Is the oximeter working at all?

This is a complex case and there may be a number of contributing causes.

Case 9

You are giving an anaesthetic for a thyroidectomy in a 45-year-old woman. Preoperatively you notice that she has a large goitre and prominent upper incisors. You induce anaesthesia with fentanyl, thiopentone and suxamethonium and then oxygenate the patient via the facemask. You proceed to intubate the patient. With laryngoscopy, all you can see is the tip of the epiglottis. You try to intubate but are unable to. You can hear the pitch of the oximeter getting lower. You look and it is reading 90%. You ventilate the patient and get the saturation up to 96%. You try intubating again using a different blade with a stylet in the tube. You are unsuccessful. You call a colleague who tries a blind nasal intubation and causes a nosebleed. By now the oxygen saturation is 80%. It is becoming increasingly difficult to ventilate the patient.

What is your management?

Expected discussion points:
• Give 100% oxygen, check ABCDE
• A – Management of a difficult intubation (anticipated or unanticipated).
  Discuss different manoeuvres – different positions, different blades, airway, LMA, bougie, stylet. Wake the patient up
• B – Consider aspiration precautions
• C – Severe bradycardia secondary to hypoxia suggests poor oxygen delivery to the heart (and therefore the brain). Commence CPR if there is a cardiac arrest.
• D – Should anaesthesia drugs be continued or stopped?
• E – What is your back up plan for a difficult airway? What equipment do you keep nearby?

Discuss management of a ‘can’t intubate, can’t ventilate’ situation; encourage the participants to keep an overview of the general condition of the patient, to call for help early, and to have a low threshold to wake the patient up.
Module 5

The WHO Surgical Safety Checklist

Saving lives through safer surgery

Aims

- To review in detail each part of the checklist.
- To divide each section into manageable parts.

Notes

- Here is the story of James.
- He had a routine operation for cleft lip and palate repair.
- He developed respiratory distress in the recovery room.
- It was discovered that the throat pack had not been removed at the end of surgery.

Notes

- Errors are common.
- Can you think of any you have seen?

Errors are often repeated...

- Wrong patient
- Surgery on wrong side
- Penicillin given to a patient with penicillin allergy
- Unexpected difficult intubation
- Anesthetist machine not checked and malfunctions
- Oxygen tank empty
- No cross-matched blood available
- Blood products given to the wrong patient
- Sponges left inside patient

Reducing complications is not necessarily a question of resources

With better use of what is available... You have the ability to improve the system

Notes

- You can reduce errors no matter where you work.
Prerequisites for safe surgery...

- Properly trained surgeons, anaesthesia providers and nurses
  - AND
  - Good preparation and planning

Notes

As well as properly trained professionals you need:
- Preparation and planning
- Plan for managing infection
- Safe, monitored anaesthesia
- Good communication between all staff
- Teamwork
- Leadership

How to reduce errors?

- Team work
- Communication
- Use of the Checklist and proper monitoring of the patient
- Practising good habits every day

WHO and safe surgery

- 386 million operations
- >7 million complications
- >1 million patients die during surgery
- 50% of complications are avoidable

Notes

- The Lancet Commission on Surgery estimates that more than 386 million operations are done each year.
- More than 7 million of these result in complications
- More than 1 million of these patients die

Results

- Deaths ↓ 47%
- Major complications ↓ 36%
- Reoperations ↓ 25%
- Infections ↓ 50%

Notes

- By utilising the checklist, we can reduce deaths by 47%, major complications by 36%, and reoperations by 25% and infections by 50%.
- The study included both high and low resource countries—Canada, New Zealand, the US, Great Britain, Tanzania, Jordan, India, and the Philippines.

How to use the WHO Safe Surgery Checklist

- Team work
- Communication
- Use of the Checklist and proper monitoring of the patient
- Practising good habits every day
Prior to induction of anaesthesia

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- Yes

Is the site marked?
- Yes
- Not applicable

Is the anaesthesia machine and medication check complete?
- Yes

Is the pulse oximeter on the patient and functioning?
- Yes

Does the patient have a:
- Known allergy?
  - No
  - Yes
- Difficult airway or aspiration risk?
  - No
  - Yes, and equipment/assistance available
- Risk of >500ml blood loss (7ml/kg in children)?
  - No
  - Yes, and two IVS/central access and fluids planned

Notes

- Before starting the anaesthetic, the first part of the checklist must be completed.
- The site must be marked by the surgical team prior to prepping and draping the patient. You must see the “surgical team mark” prior to prepping and draping the patient.

Prior to induction of anaesthesia

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- Yes

Is the site marked?
- Yes
- Not applicable

Is the anaesthesia machine and medication check complete?
- Yes

Is the pulse oximeter on the patient and functioning?
- Yes

Does the patient have a:
- Known allergy?
  - No
  - Yes
- Difficult airway or aspiration risk?
  - No
  - Yes, and equipment/assistance available
- Risk of >500ml blood loss (7ml/kg in children)?
  - No
  - Yes, and two IVS/central access and fluids planned

Notes

- The anaesthetic machine, anaesthesia drugs, monitors, oxygen and volatile agents must be checked.
- The pulse oximeter must be on the patient and working.
### Prior to induction of anaesthesia

#### Before induction of anaesthesia

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Not applicable</th>
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<td>Is the pulse oximeter on the patient and functioning?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

The potential risks must be assessed:
- Does the patient have an allergy?
- Does the patient have a difficult airway?
- Is there a risk of aspiration
- Is there a risk of major blood loss?
- Is the intravenous access adequate for the case?

### Time Out: Safety checks before starting surgery

#### Before skin incision

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Not applicable</th>
</tr>
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<tbody>
<tr>
<td>Confirm all team members have introduced themselves by name and role.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirm the patient’s name, procedure, and where the incision will be made.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

- The timeout must be completed after the induction of anaesthesia but before the skin incision.
- Has the patient’s identity been rechecked?
- Does everyone know each other and their roles in the procedure?
- Has the type and site of surgery been rechecked?
Time Out: Safety checks before starting surgery

Before skin incision
(with nurse, anaesthetist and surgeon)

- Confirm all team members have introduced themselves by name and role.
- Confirm the patient’s name, procedure, and where the incision will be made.
- Has antibiotic prophylaxis been given within the last 60 minutes?
  - Yes
  - Not applicable

Anticipated Critical Events
To Surgeon:
- What are the critical or non-routine steps?
- How long will the case take?
- What is the anticipated blood loss?

To Anaesthetist:
- Are there any patient-specific concerns?

To Nursing Team:
- Has sterility (including indicator results) been confirmed?
- Are there equipment issues or any concerns?

Is essential imaging displayed?
- Yes
- Not applicable

Notes

• Has antibiotic prophylaxis been given within 60 minutes?

Anticipate Critical Events
Surgeon?
Anaesthetist?
Nurse?

Notes

• This is a good time to emphasise how important it is to think about things that could go wrong and to think about how to manage them.

• It is the time to check that you have everything that you might need if things go wrong.
Sign out: Safety checks at the end of the operation

Before patient leaves operating room
(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:
- The name of the procedure
- Completion of instrument, sponge and needle counts
- Specimen labelling (read specimen labels aloud, including patient name)
- Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- What are the key concerns for recovery and management of this patient?

Notes
- Prior to leaving the operating room the nurse must confirm that she has counted the instruments, needles, gauzes and that the count is correct.

The surgical safety checklist

- Acts as a reminder – too many things to remember perfectly every time
- Helps to reinforce the most important steps
- Encourages the team to do the right things for every surgery

Notes
- The checklist does not replace your memory or your skills.
- Do not memorise it. Read it from a poster or printed sheet.
- It does not include everything but does contain the essentials.

Disposition of Patient
Where is the patient going post-op?
Are the orders clear?

Notes
- Is the patient going to the right place post-op e.g. ICU?
- Are the orders written and correct?
WHO: 6 steps for safe surgery

| 1. Confirm patient identity and procedure | 4. Use a pulse oximeter |
| 2. Assess the risk of difficult intubation | 5. Give antibiotics at the correct time |
| 3. Assess the risk for blood loss | 6. Count sponges before and after the operation |

Notes

- It may be difficult to begin by doing everything on the checklist.
- These 6 steps are a good starting point.
- When these are in place, then add the other steps.

Summary

- There are 3 parts of the WHO Safe Surgical Checklist:
  - before anaesthesia
  - before surgery
  - at the completion of surgery
- All team members must participate
- Each part is important in avoiding errors
- Communication is the key
Appendix
Hypoxia Action Plan

Lifebox training workshop instruction

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