lifebox
Saving lives through safer surgery

OUTL/NE
India
Social Impact through Data

EVALUATION REPORT

Impact Assessment of Lifebox Foundation's work across 4 States in India

PREPARED BY : OUTLINE INDIA | 2018

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INTRODUCTION

A significant burden of disease and mortality, especially in developing countries is due to diseases that require surgical intervention. According to a modeling study published by Lancet, 234 million people undergo operation every year – a number which is higher than childbirth across the world (Weiser et al. 2008). Out of this, 7 million people will face post-surgery complications as per current estimates, some of which are otherwise preventable by following safe surgery guidelines. This means a substantive burden of disease is comprised of post-operative risk of complications and morbidity worldwide. According to WHO estimates, the global crude mortality rate after surgery ranges between 0.5 to 5 percent.

This surgical disease burden is hard to address in poor-resource and low-income settings due to shortage of safe surgical equipment including pulse oximeters, lack of trained personnel such as anesthesiologists and inadequate infrastructure. In India for example, there are only 1.27 anesthesiologists per 100,000 people (World Federation of Societies of Anaesthesiologists Survey 2017). In crude numbers, this means India only has 12,000 anaesthesiologists with appropriate qualifications. Yet, anaesthetic services and training have largely been remained under-addressed in the public healthcare system in India.

Due to such training, resource and manpower barriers, pulse oximeters, in conjunction with use of WHO Safe Surgery Checklist and appropriate training to medical staff can serve to address the burden of surgery. Pulse oximeters in particular are widely recognized as an essential component of safe surgery internationally by WHO and World Federation of Societies of

Anaesthesiologists (WFSA). Pulse oximeters monitor the level of oxygen and pulse rate in patients, and are an essential device during operations, emergency and intensive care, recovery in hospital wards, and deliveries (WHO Patient Safety Guidelines). There are multiple studies which have proven effectiveness of the oximeter in reducing mortality and improving patient care (Haynes et al 2009). However, it continues to be absent in low-income settings. As per a study by Funk et al. (2010), funded by WHO on availability of anaesthesia and surgical equipment within surgical facilities across 769 hospitals in 92 countries, low-income sub-regions face gross shortage of operating theatres and essential surgical equipment and have poor quality of surgical care. In fact, in more than fifty percent of the hospitals, pulse oximeters which are considered the minimum benchmark for basic surgical equipment were found to be missing in this study (Funk et al. 2010).

Another important component for ensuring safe surgery is the WHO Safe Surgery Checklist. It was developed through consultations with various stakeholders, with the aim to reduce errors and adverse events, and improve teamwork and communication between surgeons, anaesthesia providers and nurses during perioperative care. As per the 19-item checklist, the whole team is supposed to perform key safety checks before inducing anaesthesia, before skin incision and before leaving the operation room. According to WHO estimates, the safe surgery checklist has proven to reduce complications and mortality by over 30 percent. As per another study which assessed the effect of the checklist in 2007 and 2008, the processes and outcomes related to surgery such as rate of deaths and inpatient surgical complications changed positively after introduction of the checklist in all 8 hospitals

under study (Haynes et al. 2009). Since then, other similar studies in different settings have shown a reduction in inpatient surgery deaths and complications while using the checklist (for example, Haugen et al. 2014; Yuan CT et al. 2012; Askarian et al. 2011; Bergs et al 2014; Treadwell et al. 2014). Kwok et al. (2013) for example found that after implementation of WHO Safe Surgery Checklist, adherence to safety processes increased from being negligible to 67 percent, and post-surgery infectious and non-infectious complications decreased substantially, after analysing data from 2145 pre- and 2212 post-intervention cases at a hospital. Consistent use of the checklist has also found to improve the overall safety culture (Kawano et al 2013; Haynes et al. 2011).

However, it is important to point out here that the success of the checklist depends on availability of technical medical equipment including oximeters, teamwork, continuous training and engagement, willingness for taking it up, local clinical champions/influencers to advocate correct use of the checklist and leadership support (WHO). Inexperienced or under-trained staff or steep authority gradients can serve as significant barriers to introduction of new equipment and practices (Kwok et al. 2013).

Success is premised on the culture of quality improvement. A QI program includes systematic and continuous activities which are organized

and implemented by an organization to monitor, assess, and improve its quality of health care services and the health status of targeted patient groups. There are numerous debates regarding specific steps comprising inputs, processes and outcomes, that is, the 'critical pathway' that is to be followed in order to deliver optimal health care services. Critical pathways may differ from organisation to organisation for it to work effectively keeping in mind the designed intervention.

While each QI program may appear different, a successful program incorporates four key principles:

Quality Improvement
In order to make improvements, an organization needs to understand its key resources (inputs) and processes (activities). Both of these must be addressed together in order to ensure or improve the quality of care (outputs/outcomes). By plotting the current critical pathway for a particular product or service, an organization gains a better understanding of what and how care is provided.

(i) Focus on patients
An important measure of quality is the extent to which patients' needs and expectations are met.

(ii) Focus on being part of the team
As a team process, it is both the knowledge, skills, experience, and perspectives of different individuals within the team that enables lasting improvements, as well as leadership, and policies and procedures to organize and facilitate the work of the team.

(iii) Focus on use of the data
Datasets are used to describe the manner in which current systems are working; the effect of changes, and to document a successful performance.
'Quality Improvement' seeks to enable an organization to achieve the ideal critical pathway.

LIFEBOX PROJECT BACKGROUND

Lifebox Foundation, an international NGO, aims to improve safety of surgery and anesthesia in low resource settings by providing training to doctors, nurses, anesthesiologists and other OT staff on the WHO surgical safety checklist and pulse oximetry. The organisation has had a range of implementation partners in India and works with professional anaesthesia societies all over the world. On starting their work in India Lifebox Foundation, approached the Indian Society of Anaesthesiologists and developed subsequent connections with other partners as well, such as Indian Society of Anaesthesiologists (ISA), Indian Society of Perinatology and Reproductive Biology (ISOPARB), Jan Swasthya Sahyog (JSS), and Apollo Hospitals.

Lifebox Foundation has in the past completed several large-scale projects across the globe in over 100 countries trying to bring about an arrangement of local leadership, partnerships, planning and evaluation that is crucial and integral to their own safe surgery philosophy. Their more recent projects include a programme to reduce risk of surgical site infection along with Clean Cut® in Ethiopia, improving anaesthesia safety in Bangladesh in partnership with Bangladesh Society of Anaesthesiologists and implementing checklist strategies in Central America.

Once a partner has been identified, Lifebox Foundations' needs assessment form is shared with them, which is then shared with hospitals in their region. Based on the information provided, a decision is taken on the basis of caseload, infrastructure and workforce on whether to engage with a hospital. Currently, Lifebox Foundation has donated high quality and environment appropriate pulse oximeters to facilitate the process. Pulse Oximeters have been donated in particular as this is the minimum benchmark among equipments mentioned in the WHO checklist.

Equipment provided

The pulse oximeters donated by Lifebox Foundation are as per the specifications mentioned in WHO Compendium – they are CE marked and FDA approved. It is manufactured by Acare Technology Company Ltd. in Taiwan. Please note, Lifebox Foundation does not promote any brand or manufacturer of Pulse Oximeter.

Training

The training provided by Lifebox Foundation is designed by senior anaesthesiologists from all over the world, some of whom are also authors of the WHO pulse oximetry training manual and Lifebox Foundation's trustees. The training content is an adaptation of the same with specifics to the oximeter provided. The trainings include modules on WHO Safe Surgery Checklist, pulse oximeters and management of hypoxia.

In India, Lifebox has distributed more than 700 oximeters in Assam, Bihar, Maharashtra, Andhra Pradesh, Telangana, Manipur and Chhattisgarh till date. Its partners include Indian Society of Anaesthesiologists, ISOPARB, Apollo, CARE and JSS.

Lifebox foundation has partnered with Outline India, as their evaluation partner, to understand the effectiveness of the trainings provided by Lifebox Foundation medical facilities, determine the uptake of medical equipment, especially oximeters during and after surgery, recall value of trainings, use, usability and routinization of oximeters, and culture of safety among practitioners. This evaluation is not to prove the efficacy of pulse oximeters, as there exists sufficient literature and medical studies to prove this. Outline India aims to assess the effectiveness of the trainings provided to medical facilities and the overall impact of the donated medical equipment on patient recovery and monitoring.

EVALUATION QUESTIONS

The evaluation primarily looked into the following:

1. To understand the hospital's use and implementation of oximeters, WHO checklist and hypoxia plan in selected facilities, and barriers therein;

2. To understand user experience and perceived impact of Lifebox Foundation's training and perception on the benefits of using oximeters;

3. To understand changes in service delivery and delivery of patient care and capture narratives of success;

4. To understand whether there is a culture of quality improvement in the facilities.

STATES INCLUDES IN THE EVALUATION
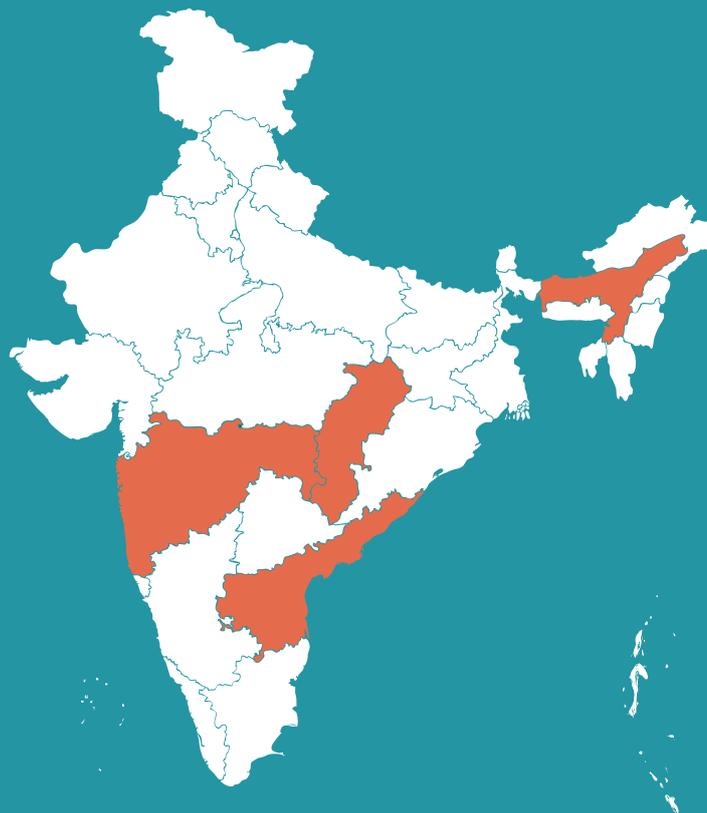
METHODOLOGY

For the evaluation of the program, a qualitative approach was adopted. In-depth interviews were conducted with key stakeholders and has been analysed thematically and fed into a content analysis framework, using the OECD DAC criteria - 'Relevance - Effectiveness - Efficiency - Impact - Sustainability'.

Stakeholders

In-depth interviews were conducted with the following stakeholders:

(i) Doctors
(ii) Nurses and OT staff

Types of facilities visited

Data collection was undertaken in 4 states in India, i.e. Maharashtra, Andhra Pradesh, Chhattisgarh, and Assam. Both public and private hospitals in rural and urban areas were selected. The following is the break up of the sampling:

Development of tools – Theory of change

For developing the interview guides, a tentative Theory of Change was developed.

(i) Inputs: Pulse oximeters, training on WHO safe surgery checklist, pulse oximetry & hypoxia management

(ii) Assumptions: Willingness to adopt new equipment; equal access to equipment; receptiveness to change and improvement among management; doctors and staff; availability of supporting infrastructure and skilled manpower

(iii) Outcomes: Routinization of pulse oximetry, safe surgery practices, improvement in patient care, culture of quality improvement

State	District	No. of facilities visited	No. of IDIs (Doctors)	Number of IDIs (Nurses & OT staff)
Maharashtra	2	16	15	13
Assam	5	6	6	5
Chhattisgarh	1	2	2	2
Andhra Pradesh	2	13	13	6
Total	9	37	36	26

The hospitals and respondents were selected based on purposive and convenience sampling. Points of contact were contacted in Andhra Pradesh when it became difficult to seek appointments with doctors in Kakinada.

FIELD WORK: Operationalisation and Ethics Compliance

IRB Approval

Institutional Review Board (IRB) Approval was sought by the Outline India evaluation team prior to the data collection process.

Written Consent and Audio Recording

Written informed consent was sought from all respondents prior to starting the interviews. If the respondent did not give consent to audio record the interview, then the interview was not audio recorded.

Interview procedure

Most interviews lasted for a duration of 30-60 minutes. Prior permissions were sought with doctors from hospitals across all 4 states by Outline India evaluators. Outline India evaluators ensured that interviews took place in a semi-private area at the hospital or nursing home.

Data Security

The data (interview transcripts and audio recordings) is saved on Outline India's server to prevent unauthorized access. Access to the server can only be gained by unique username and passwords. The data collected will be stored for a maximum of one-year. Post one-year, all transcripts and audio recordings will be deleted.

Limitations

(i) The sample size of interviewees in each of the states is not large enough to draw general inferences and trends, both, within states as well as at an overall level.

(ii) It was difficult to speak to doctors during appointment hours as there was, almost always, a queue of patients waiting to consult the doctor. Given the time crunch, we had to either cut short the interview or conduct it in parts, breaking the flow of the interview. At times, emergency cases appeared while the interview was being conducted with nurses who had to leave in between the interview. In Andhra Pradesh, for instance, doctors in Rajahmundry were unwilling to speak to the evaluation team and disclose details regarding the operations of the hospital.

(iii) The presence of the partner point of contact in Andhra Pradesh during a few interviews with doctors may have biased their opinions, leading them to give affirmative answers.

FINDINGS

1. Partnership Model

There is a different partnership model that has been adopted in each of the four states - Andhra Pradesh, Assam, Chhattisgarh and Maharashtra.

In Andhra Pradesh, the partnering organisation selected the hospitals on the basis of:

(i) Location of the hospital, with preference given to hospitals and nursing homes in rural areas

(ii) Number of doctors and nurses at the hospitals or nursing homes

(iii) Number of surgeries conducted in the hospital or nursing home

Lifebox pulse oximeters were donated to all doctors and anesthesiologists who attended the training. Apart from those who attended the training, the Lifebox oximeter was also delivered by the partner to those who were unable to attend the training. Basic instructions regarding how to use the oximeter was provided.

In Assam, the distribution of oximeters depended on the requirements of the hospital. All anesthesiologists attending the training were provided with one Lifebox pulse oximeter, barring the point of contact who received 2 Lifebox pulse oximeters.

In Chhattisgarh, the point of contact has been instrumental in the introduction of Lifebox Oximeters at his charitable hospital. Multiple Lifebox oximeters have been donated to this hospital in Chhattisgarh and its 3 sub-centres in periphery areas.

In Maharashtra, the Lifebox oximeter was donated to doctors who attended the training. These doctors mainly worked at maternity and delivery hospitals, or maternity wards of multi-speciality hospitals. Apart from this, the training was also attended by a staff member of Solapur

Municipal Corporation. He was given a number of oximeters to further disseminate to hospitals within the ambit of the Corporation.

The point of contact from Nanded was also involved in organising trainings conducted in Assam, Maharashtra and Chhattisgarh. Lifebox pulse oximeters were handed over to all doctors who attended the training as well as hospitals visited by Lifebox's point of contact. Explaining the basis of selection, he stated, "We wanted a mix of everything - urban centres and rural centres, semi-private, trust hospitals. Certain personnel were chosen to conduct training on the WHO checklist, hypoxia management, that is, what should be done in case oxygen saturation levels fall."

2. Training conducted by Lifebox Foundation

Doctors and anaesthesiologists were invited to attend a training held by Lifebox Foundation. Trainings were conducted in particular districts in Maharashtra and Chhattisgarh and for healthcare providers of different regions of Assam and Andhra Pradesh.

A senior resident doctor working at a charitable hospital in rural Bilaspur, Chhattisgarh stated, "It was about pulse oximetry, its principles, how to use them and precautions to be taken regarding the use of the equipment. Apart from this hospital, we have sub-centres too. The training was for them as well to understand how to better utilize the equipment in those settings. We were already familiar with pulse oximeters but our peripheral workers and village health workers come with very basic training. But the Lifebox training has been more useful for them"

Topics of discussion

The content of the training was standard and was provided by Lifebox Foundation. The primary topics of discussion were:

(i)   Safe surgery practices - Key monitoring tools, WHO checklist

(ii)   Hypoxia action plan

(iii)   Case studies highlighting the use of Lifebox oximeter

(iv)   Demonstration of the Lifebox pulse oximeter - Use and maintenance

Given the difference in points of contact in each of these states, findings suggest a slight variation with respect to how the training within the states was conducted, in terms of the participants invited, and the distribution pattern of oximeter donations.

Attendees

There was variation in terms of who attended the training across all states included in the evaluation.
(i) For instance, in Andhra Pradesh, the training was attended by doctors involved in different stages of surgery including anaesthesiologists. A doctor working in rural Yelamanchili stated that it was not feasible to send their OT nurse given how short staffed his private nursing home is.
(ii) In Assam, training was attended only by anesthesiologists.
(iIi) In Maharashtra, with an exception of one hospital from Nanded, no other nurses or OT staff attended the training.
(iv) In Bilaspur, Chhattisgarh, a total of approximately 50 doctors, nurses, peripheral health workers and village health workers from the hospital attended the training.

Key takeaway and suggestions

Qualitative data collected for the evaluation a couple of months after the training had been conducted demonstrated that all those who attended the training found it to be useful.

(i)   The training was especially useful for

the staff working at peripheral areas who come with basic training.

(ii)   A key finding of the evaluation suggests that all doctors felt the need for more such trainings at regular intervals.

"Lifebox Foundation should focus on peripheries. They should select some peripheral centres wherein training should be given. The training on Hypoxia, for example, was very helpful. The government and private organizations should try to help the patients through local hospitals. They should strengthen the government hospitals and the qualified doctors in the periphery who are willing to treat the patients", stated a doctor working at a rural hospital in Yelamanchili, Andhra Pradesh highlighting the need for similar trainings in rural areas.

3. Usage of the Lifebox pulse oximeter

Availability

While oximeters have been in use at most hospitals across all states included in the evaluation well before the introduction of the Lifebox pulse oximeter, it is clear that Lifebox's oximeter donation has made the most impact in Primary Health Centres (PHCs) and Community Health Centres (CHCs).

Most hospitals have multiple types of oximeters available, such as finger oximeters, Lifebox pulse oximeters, as well as the multipara monitor oximeter. What differs is the number of oximeters available at each of the hospitals. PHCs and CHCs visited across Maharashtra and Andhra Pradesh only have one Lifebox pulse oximeter highlighting the need for more oximeters at these facilities. A doctor working at a PHC in Solapur, Maharashtra stated, "When we did not have any oximeter, we chose to perform surgery only on healthy people. Ever since we have received the LifeBox pulse oximeter, we have been able to take better care of patients who have complained of suffocation."

Case study : Lifebox oximeter availability in a rural PHC in Andhra Pradesh

A PHC located in rural Tallapudi, Andhra Pradesh did not own any oximeter before receiving the Lifebox Oximeter in January 2018. The doctor found the oximeter to be very useful during both, surgeries and post-operative monitoring. The Lifebox oximeter is now used in surgeries, emergency cases, heartache, breathlessness etc. It is also used during the preoperative phase to monitor the vitals of the patient. During surgery, it is connected continuously. But during pre- and post-operative monitoring, it is connected at intervals by the nurse. The vitals are then reported to the doctor in case of any irregularity.

Dissemination by partnering organisations

Evaluation data shows that the number of Lifebox pulse oximeters distributed at all health facilities varied amongst and within states included in the evaluation. However, the basis of dissemination of oximeters remains unclear.

Use cases

Data collected suggests that the use case of different types of oximeters varies from hospital to hospital. Most doctors have their personal finger oximeter which they carry with themselves during routine ward check-ups. They have been using this widely prior to the introduction of Lifebox pulse oximeters. On the other hand, the multipara monitor oximeter is mainly used in the ICUs and operation theatres during surgeries since it has the ability to measure other vitals in addition to the oxygen saturation and pulse rate. In certain cases, it is also used in the casualty room and the patient's room post-operation.

The Lifebox pulse oximeter is almost a cross between the large multipara oximeter and the portable finger oximeter.

Given its portability and easy application, the Lifebox pulse oximeter is used for a variety of purposes ranging from emergencies a hypoxia management, OPD, post-operative monitoring and even to transfer patients from one ward to another. Nurses and doctors reported several cases where they use Lifebox oximeters to diagnose hypoxia, as well as preventive measures in post surgeries till it is believed that the patient is stable.

(i) In PHCs and CHCs across Andhra Pradesh and Maharashtra, the Lifebox pulse oximeter is used during surgeries as well given the availability of just one Lifebox pulse oximeter at these centres.

(ii) In Chhattisgarh, Lifebox pulse oximeters are present in every ward of the hospital to monitor patients post surgeries.

(iii) It is also reported to be used in ambulances at a private hospital in Maharashtra.

Usage and reporting by hospital staff

With regards to usage of oximeters, findings across all states suggest that the Lifebox pulse oximeter is primarily used by nurses or the OT staff who connects it to patients to check the oxygen saturation level and pulse rate.

However, despite nurses and OT staff being the primary users of the oximeters, the prevalence of strong hierarchical structures often restricts nurses or OT staff from taking any action based

Case study : Routine usage of oximeters in a charity hospital in Chhattisgarh

In Chhattisgarh, before receiving Lifebox pulse oximeters, multipara oximeters were primarily used during surgeries and for other patients on a priority basis at a charity hospital in Bilaspur. There has been a considerable increase in the use of oximeters at the main centre as well as sub-centres located in periphery areas who are finding it useful to diagnose a patient using the Lifebox pulse oximeter.

on the oximeter readings, prior to a doctors approval. In most cases, nurses or OT staff merely report the readings or bring the criticality of the situation to the notice of the doctor or the medical official on duty.

(i) In small nursing homes in rural Andhra Pradesh, the nurses are allowed to use the Lifebox pulse oximeter only under the doctor's supervision.

(ii) In Assam, on the other hand, doctors encourage nurses to use the oximeter during routine checkups and in cases of emergencies.

Non-use

While on the field, the evaluation team came across instances wherein the Lifebox pulse oximeter was not being used at all. In both the below mentioned cases, the doctors had not attended the training given by Lifebox Foundation.

Given that one of the criteria for the selection of hospitals in Andhra Pradesh was the number of surgeries performed, it becomes unclear as to why these nursing homes were provided with the Lifebox pulse oximeter.

(i) A retired doctor who had shut his private nursing home in Kakinada, Andhra Pradesh 5 years ago was provided with a Lifebox pulse oximeter by the partner organisation. Given that he had stopped practising, he gave away his Lifebox oximeter to his son who is a practising doctor and works at a corporate hospital in Hyderabad.

(ii) At another private nursing home, the doctor had not even unpacked the box in which he had received the Lifebox oximeter. The reason for this being that the doctor did not perform surgeries at his nursing home, and felt that the oximeter would be more useful for hospitals where there are in-patients, and not at a clinic like his.

Access

Gaining access to the Lifebox pulse oximeter is similar between hospitals across all four states included in the evaluation with almost all staff members having access to it. In most private hospitals, the OT or ward staff who is on duty has access to the oximeter.

(i) As a measure of accountability, nursing homes in rural areas of Andhra Pradesh and Assam require staff to seek permission from or at least inform the OT technician or ward in-charge prior to using or borrowing an oximeter belonging to a different ward.

(ii) Similarly, at the charity hospital in Chhattisgarh, each ward has its own inventory. Oximeters for each ward are kept in the inventory of that ward, and the ward-in-charge is responsible for maintaining an entry of the equipment kept in the inventory. All the nurses in the ward have access to it. They also have a strong method of transition of duties, wherein when the shift changes, they inform and provide the details to other nurses. In case there is an issue with the oximeter, the ward-in-charge is responsible for contacting the maintenance team who is further responsible for getting it repaired by the company technicians.

Non-Access

Respondents also reported a few cases where they did not have access to oximeters easily. For instance, a PHC in rural Tallapudi, Andhra Pradesh kept oximeters locked inside the doctor's cupboard, and oximeters could only be used by the nurses under the supervision of the doctor. Similarly, a nurse working at a public urban maternity home in Solapur reported that the lifebox oximeter is usually kept locked inside the cupboard in the doctor's cabin and can only be accessed upon seeking permission. These instances, though lesser in number, do prevail.

Storage

Some common storage areas include the operation theatre, the store room and the doctor's OPD room.

Duration of use

The duration of use during the post-surgery stage differs across hospitals in each state. For instance, while some hospitals in Andhra Pradesh and Assam may initially use it continuously for a few hours, following which they monitor patients intermittently every 15-30 mins post surgeries to ensure that the patient is stable. In other cases, respondents mentioned that the oximeter is helpful in transporting patients to the ward post surgery.

"If a patient collapses outside, we cannot carry the multipara oximeter. It is the Lifebox oximeter which proves to be helpful in such a case as it is portable", stated a doctor running a nursing home in rural Yelamanchili, Andhra Pradesh.

NARRATIVES OF SUCCESS :
Usage of the Lifebox pulse oximeter

"Snake bites are very common in these villages and the victims of snake bites often go into respiratory paralysis. These victims are often required to be shifted to better equipped facilities. In the absence of oximeters, our peripheral workers tried to give the patients oxygen and put them in a position that prevents their condition from worsening. This is a difficult procedure to do without a pulse oximeter. Oximeters help in understanding the patient's actual oxygen saturation level." stated a doctor working at a charity hospital in Bilaspur, Chhattisgarh

"During a medical camp, a young boy went through an appendix operation and suddenly got a cardiac arrest. We immediately connected him to the Lifebox oximeter and identified the problem at an early stage and saved his life", stated a doctor working at a public medical college in Nanded, Maharashtra.

"I organise camps in the rural area. In December, an asthmatic patient approached me. He thought he was suffering because of the cold but he was confused and couldn't explain what was happening to him. So I felt that his saturation level was low - turns out it was 68%. The previous night, he had taken an injection from a local doctor hoping that his condition will improve over time. After checking his oxygen level using the Lifebox oximeter, an emergency ambulance was called where I connected him with the oxygen cylinder. Within minutes his saturation level increased. Once I was working in a periphery hospital where there were no oximeters. There was a delivery at midnight - suddenly the mother became dyspneic and couldn't breathe. When I connected the oximeter, her saturation level was hardly 80% and she had variable heartbeats. That time I had to shift her to another hospital." stated the director of a private hospital in Kakinada, Andhra Pradesh. Impressed with the battery life, he uses the Lifebox oximeter as his personal device and uses it every time he has to go to the field to conduct medical camps. Prior to the introduction of Lifebox Oximeters, he would use the finger pulse oximeter to examine patients.

"There are patients who consume insecticide. They do not reveal anything about their condition which makes it difficult to assess the patient. By using the pulse oximeter, we could check the pulse rate and the saturation levels", stated a doctor working at a PHC in rural Solapur, Maharashtra.

Record of readings

The readings from the oximeters are recorded by the nurses in the patient care sheet, case sheet, OP sheet, or at times, they are even reported to the doctor in real time in case of emergency.

(i) In Chhattisgarh, records are maintained for a period up to 1 year at the hospital itself after which they are filed for storage. These records come in handy in cases wherein patients visit the hospital for follow-ups without their discharge papers.

(ii) In Assam, multipara monitor oximeter readings are noted down during surgery in a record book that is maintained.

4. Barriers and challenges to using the Lifebox pulse oximeter

Technical challenges with the device

Data collected suggests that although a majority of doctors and nurses did not face any major challenges with the oximeters, there were occasional complaints regarding the poor battery life of the Lifebox pulse oximeter. In Assam, a doctor also complained of the oximeter screen turning white in case of low battery during a surgery.

There have been a few cases wherein the Lifebox pulse oximeter has shown wrong readings. In such cases, patients were connected to the multipara oximeter to cross check the readings, along with manual readings. One of the nurses also mentioned that they preferred finger oximeters over the lifebox pulse oximeters for regular check-ups. This is because although both oximeters are portable, the finger oximeters are easier in their application. The quote below highlights this finding:

"More than this Lifebox oximeter, what we prefer is the small oximeters (finger oximeters) that we already have in each ward. Those are more handy than carrying this. We already carry the BP apparatus. This also has a wire attached..(making it difficult for them to use it as compared to the finger oximeters)", stated an OT nurse at a private hospital in Jorhat, Assam.

Maintenance

With respect to regular maintenance and care of the lifebox oximeters, doctors, nurses and technicians across all the four states are aware of how to maintain the Lifebox pulse oximeter and were responsible for its maintenance. None of the respondents stated any issues in the maintenance or in the oximeter having added to their work tasks.

Redressal mechanism

Majority of the doctors at the hospitals and nursing homes visited for the evaluation were unaware of whom to report to in case the Lifebox pulse oximeter stopped working. There is a need for a more systematic approach that needs to be adapted and the redressal procedure to troubleshoot problems needs to be explained more clearly at the time of training.

Looking at the state-wise variation, a doctor from a private nursing home in Rajahmundry, Andhra Pradesh, returned the Lifebox pulse oximeter to the local partner who had accompanied us. The doctor stated that no phone number or email ID had been provided to him for troubleshooting issues. In most hospitals in Maharashtra, we received a mixed response pertaining to redressal issues, as only some of the respondents knew the procedure to be followed, while others did not. In contrast to this, ward in-charges in Chhattisgarh, who are responsible for the maintenance of the equipment are aware of persons to contact.

5. Hypoxia Management

As the Lifebox pulse oximeter displays the two most crucial readings needed to detect and

manage hypoxia - oxygen saturation and pulse rate; it has proved to be a handy tool that can be connected to a patient to detect hypoxia at the earliest, saving a lot of time in comparison to the multipara monitor oximeter which isn't easily portable.

Before the provision of the Lifebox Oximeter, a PHC located in rural Tallapudi used to visually diagnose hypoxia cases.

The Lifebox pulse oximeter is also beneficial in both, detecting hypoxia, as well as monitoring a patient after supplying oxygen. A doctor at a private nursing home in Solapur spoke of a case that happened in another hospital wherein the oximeter would have proved to be helpful if they had one. Stating the instance, "a patient had undergone surgery and was shifted to the recovery room where he was sleeping. The patient was not monitored since there was no oximeter present in the recovery room. After surgery, the patient suffered from hypoxia. Due to the absence of any monitoring procedure, the situation went unnoticed resulting in the loss of the patient's life." These errors, although rare, can occur in the absence of monitoring. Hence, it is crucial to monitor the patient at all stages of a surgery.

"After administering oxygen, the Lifebox oximeter informs you whether the patient is responding to the treatment or not, or whether the patient has stabilized or not, " stated a doctor working in a private nursing home in Solapur, Maharashtra

Awareness regarding the hypoxia management plan

Findings demonstrate that although all doctors are aware of hypoxia and could list out steps to be followed in case a case of hypoxia emerges, most nurses and OT staff, although familiar with the symptoms of hypoxia, are not aware of the terminology per se. Hence, when asked about hypoxia, we sometimes received a negative

response. Looking at the overall trend across all states included in the evaluation, it is mainly doctors who provide information to nurses on how to handle hypoxia cases.

(i) In Andhra Pradesh, there is a stark difference regarding the knowledge of hypoxia between doctors and nurses. Doctors are aware of what is to be done when a patient has hypoxia, while nurses had never come across any patient suffering from hypoxia.

(ii) In Assam, nurses use the lifebox oximeter to check the patient's vitals if and when patients complain of breathlessness; following which they usually inform the doctor about the issue and in some instances administer oxygen themselves.

(iii) Nurses in Chhattisgarh inform the doctors at the main centre if the patient is hypoxic and follow instructions over the phone. Patients are connected to an oxygen cylinder in case the need arises and monitored using the LifeBox pulse oximeter.

(iv) Both doctors and nurses in Maharashtra are aware of the hypoxia management plan to be implemented if and when they come across a case of hypoxia and administer oxygen to patients when the oxygen saturation levels drops below 95.

Detailing out the hypoxia management plan that is followed, a doctor working at a charity hospital in Bilaspur, Chhattisgarh stated, "We follow the ABC plan- airway, breathing, circulation, for resuscitation. If there is an emergency case - you check the vitals, attach monitors and check the response rate of the patient. We check his airway, whether the patient is able to talk, then we check their breathing. Thereafter, we check the blood circulation and their blood pressure level. In this hospital there is piped oxygen supply. The first step is to put on the mask and supply oxygen to the patient, the nurses then see if the oxygen saturation level is improving or not and inform the doctor".

6. Safe Surgery Protocols

Internal safe surgery protocols

Doctors and nurses were taught about the WHO checklist at the training conducted by Lifebox Foundation. However, findings suggest that most hospitals across the states have internal protocols which are followed pre, post and during surgeries. Only a few hospitals have checklists that are followed. Instead, many respondents mentioned that since they had knowledge and experience, they are well-versed with the surgery protocols and do not feel the need to refer to a checklist at each stage of the surgical process.

One of the private hospitals in Jorhat, Assam employs a very strict protocol of following pre and post surgery checklists for doctors and OT staff and could readily present it to the evaluation team upon being asked. In contrast to this, even though a doctor from another hospital in the same location mentioned that their checklist was adapted from the WHO checklist and was regularly used, he could not provide the evaluation team with the checklists when asked, as they were unavailable at that time. This unavailability of checklists, perhaps, indicates the lack of its use. Similarly, in a few hospitals in Maharashtra, nurses and doctors were familiar with the WHO checklist, although they were unaware of the technical term for the same. These discrepancies highlight the lack of use of checklists and implementation of robust protocols, even if the staff is well trained and experienced to run all operations smoothly.

WHO Checklist

While doctors acknowledge the importance of the WHO checklist, some also felt that it needs to be adjusted in accordance with the local context. The case study provided below highlights the same:

Stressing on the importance of localising the WHO checklist, a doctor working at a private nursing home from Visakhapatnam, Andhra Pradesh stated, "....Protocols should be created for everything. But what we, doctors, are made to use are higher standard protocols. These protocols are developed in other countries. We ape the protocols used by them blindly. We don't differentiate between what is necessary for our country. The protocols are true, but some of the protocols should be based on the local context. What we should do is give the patient what is necessary, and not follow protocols. We won't be able to follow exactly the same protocols for every case. Protocols should be locally made. We shouldn't blindly ape protocols made in the West. I feel we don't have locally designed protocols because we don't spend much money on research. So whatever Americans give, we follow that. We don't focus on research as much as we should."

Implementation of safe surgery protocols

Findings indicate that there is a clear division of tasks and responsibilities to ensure that surgeries are conducted in a smooth manner. In all hospitals, it was reported that either the anesthesiologist or the surgeons are responsible for maintaining a checklist of items that are required pre and post surgery. The most common procedures is is as follows - Nurses commence the process by running all necessary tests such as checking the patient's blood pressure, ECG, liver function, blood sugar level, urine test, thyroid screening etc. The OT technicians and/ or nurses prepare the operation theatre with all the necessary equipment before the (visiting) surgeons perform the surgery. A patient chart is also maintained in all hospitals with the patient

information recorded for the medical officer's, surgeon's and/or anaesthesiologist perusal. The OT staff is also responsible for assisting the surgeon during the course of the surgery.

Post-operative care

Post-operative care is ensured mainly by the ward nurses, with regular monitoring by the doctor responsible for patient care. During this time, the vitals of the patients are carefully monitored and if any irregularity is observed, the same is reported to the doctor. This is considered critical for the effective recovery of the patient.

"We do it regularly. There isn't any time to follow some list, because there is continuous rush one after another", said an OT technician and nurse from Sibsagar, Assam upon being asked whether they follow any protocol list.

7. Quality Improvement

One of the most important indicators for Quality Improvement (QI) is the existence of a strong quality control team to look after the smooth functioning of the medical centre. Although most hospitals across the states included in the evaluation have QI teams, there exist barriers to smooth and effective QI in hospitals. Findings reveal a difference in trends of QI teams in public and private hospitals. For instance, there were QI teams at the charity hospital in Bilaspur, Chhattisgarh, government hospitals across Andhra Pradesh and most hospitals in Assam. In fact, one of the charitable hospitals in Golaghat, Assam visited for evaluation had external auditors for annual quality checks. The hospital also collected feedback forms from patients about the quality of services and areas of improvement. However, almost all private hospitals and nursing homes in Andhra Pradesh

lack quality control teams which is crucial to ensuring improved quality of care in hospitals.

Hierarchical structure

Data collected suggests that strong hierarchies existed in all the hospitals visited, with nurses having to report to doctors for all tasks. Nurses in Andhra Pradesh, for instance, were reluctant to participate in interviews without seeking permissions of the doctors.

As nurses in private hospitals are not adequately trained, they are bound to consult doctors before checking a patient's vitals and administering medication. Doctors, too, are not confident in trusting nurses or OT staff with tasks. A doctor working at a private nursing home in rural Visakhapatnam stated:

"Here you can't leave anything up to the nurses. Because the responsibility is of the doctor. Whatever we do, the focus is on the doctor only. In a small nursing home, only one doctor is there who is targeted. The doctors only should implement protocols and not the nurses. You can give training to nurses but they should not do anything individually. Because at the end of the day, it is the hospital which is responsible for everything." - Private hospital Doctor, Visakhapatnam, Andhra Pradesh

Shortage of manpower and lack of advanced equipment

Apart from some private and charitable hospitals, most hospitals reported the need for better and updated equipment. PHCs in Maharashtra reported a shortage of manpower and medicines, and although they regularly conveyed their concerns to higher authorities, there were delays in providing them with required equipment. For instance, one of the doctors in a private hospital in Jorhat, Assam mentioned that although their hospital had all the basic equipment, they would of course prefer to use more advanced

equipment. However, as this equipment was not extremely necessary, they were not frequently updated by the management. The quote below illustrates this finding:

"All basic requirements are met, but machines cannot be upgraded to the best ones since they are costly. Since all our machines are working, they are not providing us with new ones. That is the problem with all hospitals." stated an anesthesiologist at a Private Hospital in Jorhat, Assam

Trainings

In terms of trainings provided for quality improvement, there were occasional trainings conducted for doctors and nurses, albeit at different levels. While doctors attended trainings, conferences and workshops organised by external organisations, nurses and other OT staff are trained internally by doctors and senior staff regarding the handling of equipment, medicines, patient care, and protocols for pre and post surgery. All doctors felt that training of nurses is crucial since they are the ones who serve as the first point of contact for patients and are responsible for monitoring the patient on a timely basis. Such perceptions on training and monitoring highlight an open and strong quality improvement culture.

As such, there seems to be a need for further trainings, especially for nurses and the OT staff. This was stated in many of the interviews with the staff.
(i) Doctors at private hospitals in Maharashtra complained of nurses not being adequately trained.
(ii) OT technicians and nurses at a CHC in Sibsagar, Assam mentioned, that they would specifically like training on the use of different equipment and OT techniques.

PHC doctors in Andhra Pradesh and Maharashtra mentioned that nurses at their hospital are trained better than those employed at private hospitals since they are provided training under government national programmes. The quote below best explains this finding:

"Since this is a government hospital, nurses receive training under national programs on new vaccines, deworming etc. Nurses attended a recent training under Mission Indhradhanush wherein they were trained on immunization for 0-5 year old children." - Doctor at a PHC in Andhra Pradesh.

However, doctors from private hospitals in Andhra Pradesh stated that a common challenge faced by them was the retention of nurses in the organisation. One doctor stated:

"The challenge is that nurses leave after the training. Most of the corporate hospitals face this problem, that is, the time span for which the nurses stay at a hospital has come down. Previously in my old hospital, nurses used to stay for even 10 years. Now the trend has changed. They work here for 1-1.5 years and go to a different hospital. "

This is a relevant factor for quality improvement as well trained staff ensure the smooth running of all operations and protocols.

Accountability

Another indicator of a robust quality improvement culture is accountability and standardisation of services. As mentioned earlier, even though most hospitals followed pre-and post-surgery protocols, the staff did not always follow checklists as a quality check. The lack of belief in such protocols highlights the need for a stronger quality improvement culture.

Need for stronger culture of QI

Overall, despite most hospitals having quality improvement teams, there were several challenges that the doctors and nurses faced. In such cases, nurses reported the issue to their immediate seniors and doctors often relied on the management to take the necessary actions. Therefore, a stronger culture of QI and training could be beneficial for improving services provided by the hospitals.

SUMMARY | CONCLUSION AND FUTURE NEEDS

The evaluation conducted surfaced several trends and patterns at an intra- and inter-state level. It also identified challenges and developments that can potentially help Lifebox in making certain implementation strategies. Listed below is a broad overview of the findings of the evaluation.

1. Dissemination of Lifebox pulse oximeters by state-wise partners

Lifebox oximeters were distributed by state wise partners in each of the states included in the evaluation, namely, Andhra Pradesh, Chhattisgarh, Assam and Maharashtra. Although a needs assessment was carried out prior to dissemination of Lifebox pulse oximeters in each of the states, the evaluation conducted suggests the need for restructuring the strategy adopted by partners in terms of selection criteria for hospitals and nursing homes where the oximeters were donated. Findings demonstrate that there was no clear basis on which oximeters were distributed at the healthcare facilities. As mentioned in the earlier sections of the report, most hospitals already had access to oximeters before the introduction of the Lifebox pulse oximeter. However, it does serve as a crucial equipment for most hospitals in rural and remote areas, such as in Chhattisgarh and Andhra Pradesh, where the impact of oximeter donations is maximum. Data suggests that there is a greater need for oximeters at PHCs and CHCs who can benefit from it much more rather than corporate hospitals which already have a large number and wide variety of oximeters available at their disposal. Highlighting the need for oximeters in rural areas, a doctor working in a private nursing home in rural Yelamanchili,

Andhra Pradesh stated, "In corporate hospitals, the lifebox (oximeter) will not be useful. This will only be useful in peripheral areas and should be provided more to small peripheral centres and nursing homes. We are also going to buy one for the ambulance as monitoring in the vehicle is also important."

Future distribution of oximeters, henceforth, should be based on the location (urban-rural), size and capacity of the hospital, such as the number of wards present at the hospital/nursing home, the number of surgeries performed in a day and the number of patients admitted on an average day to ensure maximum impact of the Lifebox oximeter.

(i) For instance, in the case of Andhra Pradesh, as mentioned earlier, oximeters had been distributed in nursing homes where surgeries were not performed, eliminating the need for the Lifebox oximeter. In certain cases, the availability of more oximeters in PHCs and CHCs would prove to be more beneficial, given the availability of just one oximeter at present.

(ii) In Assam, the Lifebox oximeter was given to only anaesthesiologists who attended the training.

(iii) In Chhattisgarh, on the other hand, oximeters were available in each ward in the hospital included in the evaluation. The values and practices of the hospital administration translated into routine usage of the Lifebox oximeter. The availability of multiple oximeters proved to be helpful, ensuring usage of the oximeter at all stages of the surgery.

A thorough needs assessment prior to donation of oximeters may be more beneficial for future partnerships. This will ensure optimal usage of the device and ensure that resource low

facilities that are the most in need of oximeters are provided with them; thereby resulting in routinised usage and improvement in patient care.

2. Trainings

(i) Training for nurses, OT staff: It is crucial to conduct in-depth trainings at regular intervals to ensure safe surgery practices. Doctors across all four states highlighted the need for trainings for nurses and the OT staff showcasing the need for inclusion of more people at trainings. In fact, a doctor working at a PHC stated that the Lifebox oximeter is merely an equipment to facilitate better monitoring and does not actually save the lives of the patients. According to him, it is up to the doctors to ensure patient care. Hence, conducting regular trainings can help improve patient care.

Since the oximeter is mainly used by the nurses/

OT staff to diagnose and monitor patients, it is important that information regarding the use of oximeters be given to them directly rather than being passed on by the doctor since they are the primary caretakers of the patients. As of now, trainings are mainly imparted to the nurses by the doctor on the job, instead in the form of classroom sessions. Such training would lead to better preparedness at the ground level and be instrumental in sustaining improvement in the quality of care provided at these hospitals and nursing homes.

(ii) Trainings at rural facilities: Although there are trainings conducted for nurses at all facilities by the doctors, there is a greater need to conduct frequent trainings, external and internal, at rural health facilities.

(iii) Trainings developed for local requirements: There is a need to contextualise trainings depending on patient cases that are most

common in a particular hospital or nursing home. For instance, a doctor in Andhra Pradesh mentioned that as they receive several cases related to road accidents, procedures is most relevant to them. Doctors and nurses at other health facilities also stated similar requests. Therefore, in addition to trainings on oximeters and the WHO checklist, it would be helpful to extend training on topics relevant to patient cases that are most common in that area. This can be assessed during the needs assessment by future partners.

3. Impact of Lifebox pulse oximeter on improving safe surgery practices

The Lifebox pulse oximeter is proving to be a useful tool in improving patient care to a certain extent. However, there are cases wherein the Lifebox oximeter donations has had a higher impact, for instance, in PHCs and CHCs which did now own an oximeter prior to receiving one by Lifebox. In such cases, the pulse oximeter has proved to be highly useful in monitoring patients.

Findings suggest that if oximeters are donated to hospitals based on their capacity and surgeries undertaken, it would be more successful in bringing about a change at the institutional level and promoting quality improvement to ensure safe surgery.

Given its portability and ease of use, it is being widely used at the health care facilities included in the evaluation. Some of the most frequent uses of the oximeter are regular checks, at the time of emergencies and for post-operative care. Hierarchical barriers prove to be a deterrent when it comes to ease of availability of the oximeter. Although nurses are responsible for checking the vitals of patients, they are required to seek permission from doctors. This practice is widely common across almost all hospitals and nursing homes in all states. In order to increase the use of oximeters, it is crucial for nurses to have easy access to the oximeter, thereby improving the quality of care provided to patients.

Majority of the doctors visited were unaware about whom to contact in case they faced a problem with the Lifebox oximeter. Hence, there is a need to improve the redressal mechanism and clearly specify the contact person in case a problem with the Lifebox pulse oximeter emerges. Merely stating a phone number on the device package is not helpful.

4. Safe surgery protocols

All hospitals and nursing homes included in the evaluation had internal safe surgery protocols which were implemented before, during and after surgeries. The responsibility of maintaining this checklist belonged to the anaesthesiologist. The WHO checklist, as such, is not followed by hospitals. The internal safe surgery checklist followed is similar to that of the WHO checklist and has been adapted from it. The most critical part of post-operative care is meticulous monitoring of the patient's vitals. The nursing staff uses the pulse oximeter to monitor patients and the observed readings are reported to the medical officer in charge or the surgeon.

5. Basic infrastructure and equipment

In addition to oximeters, hospitals stated the need for other equipment that complements the use of the Lifebox pulse oximeter. One of the doctors working at a private nursing home in a rural periphery area stated the need for oxygen cylinders - "Oximeters have been provided, but if the oxygen level is low, the first aid that we require is oxygen." Therefore, there exists a need for other basic equipment as well which may be helpful to provide support to the use of oximeters.

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