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## CASE STUDY

### Reducing the radiological exposure of neonates and cost of care in the Neonatal Intensive Care Unit at a private hospital in Bangalore, India

#### Summary

Ovum Hospital is a private, for-profit maternity hospital in Bangalore. Ovum provides 24-hour maternal and pediatric care and admits an average of 25 babies to the Neonatal Intensive Care Unit (NICU) per month. Neonatologists and nurses at the hospital were concerned that newborns were being exposed to unnecessary X-rays. In November 2016, staff from Ovum Hospital attended a two-day workshop on quality improvement approaches (QI) conducted by the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project. During the workshop, teams prepared a real-life quality improvement project that they could implement in their facility. The Ovum Hospital team decided to reduce X-ray exposure of neonates. They identified two factors contributing to this problem. First, many babies had to undergo repeat radiological examination when the quality of the original examination was poor. Second, X-ray examinations were being done routinely to locate the tip of umbilical venous/arterial cannulas (UVC/UAC) when ultrasounds could be used instead. By analyzing the root causes of these problems, they were able to devise and implement effective changes to the procedures and processes of care in the NICU to reduce unnecessary X-ray examinations; thus, reducing radiation exposure and the cost of care for high-risk infants.

#### Background

Ovum Hospital is a 40-bed private, for-profit maternity hospital in Bangalore. Ovum provides 24-hour maternal and pediatric care and admits an average of 25 babies to the Neonatal Intensive Care Unit (NICU) per month. The neonatologists and nurses at the hospital were concerned that newborns were being exposed to unnecessary X-rays. They identified two factors contributing to this problem. First, many babies had to undergo repeat radiological examination when the quality of the original examination was poor. Second, X-ray examinations were being done routinely to locate the tip of umbilical venous/arterial cannulas (UVC/UAC). Umbilical venous/arterial cannulation in high-risk neonates is done to help in the administration of medication and parenteral nutrition and frequent blood sampling. The clinicians need to locate the tip of catheter to ensure that it is just above or at the level of the diaphragm. It is also recommended that the catheter be out of the heart chambers and not in the liver lobes. Ensuring correct placement of the tip of umbilical venous/arterial cannulas (UVC/UAC) helps to avoid medical complications that can arise from incorrect placement.

The hospital does not have an in-house radiologist or radiology department but uses portable X-ray and point-of-care (POC) ultrasonography machines. Neonates admitted to the NICU have an X-ray taken by nurses using portable machines, when indicated. The films are then sent to another facility to be read by a radiologist. In October 2016, the radiologist requested that 37% of X-rays be repeated because of technical problems. In addition, babies with UVC/UAC received routine X-rays to locate

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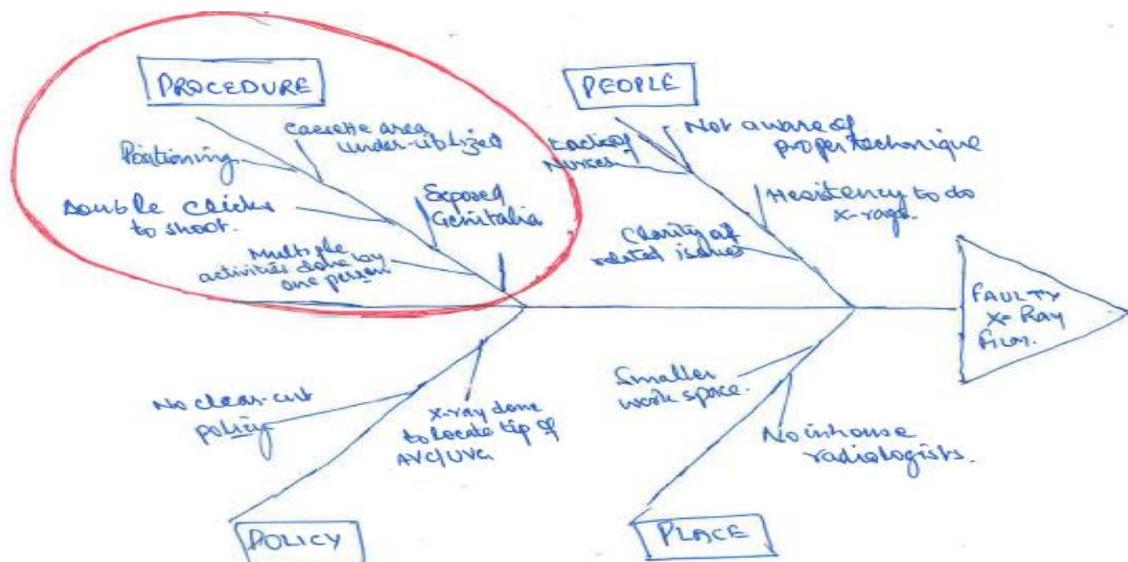
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the tip of the cannulas even though ultrasound is a safer and faster method. All investigations (100%) done to locate cannula tips were conducted using X-rays.

In November 2016, the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project conducted a two-day workshop in Bangalore to train teams from 27 public, private, and academic medical facilities across South India in QI approaches. All the teams learned how to select a problem to work on, identify gaps in care, set an aim, and begin developing and testing process changes to improve care. In addition to learning improvement approaches and theory, all teams also prepared a real-life quality improvement project that they could implement in their facility. The Ovum Hospital team decided to reduce X-ray exposure of neonates.

### Problem analysis

The team used a fishbone analysis to identify factors that led to repeat X-rays.



Fishbone diagram that QI team at Ovum Hospital, Bangalore created to analyze problem.

The fishbone analysis helped the team realize that the person taking the X-ray was responsible for multiple tasks, including positioning the baby, positioning the X-ray machine, and taking the X-ray image. The baby often moved while the machine was being positioned and the picture taken, which led to poor quality images.

### Implementation of the QI work

#### **How the team reduced the number of repeated X-ray examinations:**

Based on the analysis, the team decided to change how they conducted the X-ray examination:

- Involve an extra person in taking the X-ray:** To fix the problem of poor quality films due to one person doing multiple activities, the team decided to try including one more person in the process of taking an X-ray to hold the baby still. At any point during a shift, three or more staff nurses were on duty. So, the team discussed the possibility of using two staff nurses to take the X-ray film. Initially, people who were not previously involved in taking X-ray films were very hesitant to help because they were afraid of being exposed to radiation. The neonatologist explained to one of the staff nurses how she could avoid radiation exposure by wearing a lead apron. The nurse got ready to test the idea of providing extra help to hold the baby stable in two cases. One extra lead apron was requisitioned from the hospital stores and used while the test was done for the two babies. The quality of the films was good in both cases. It was also observed that involving one extra staff nurse did not make any other activity suffer. The team shared the results with all the remaining staff nurses and decided to adopt the change for a week involving all the staff nurses in every shift. After one week, when all the films were of good quality, the staff nurses involved in the process were further trained

by the neonatologist in how to conduct and support an X-ray examination. A new departmental protocol was established that two staff nurses should be involved in taking an X-ray film: one to conduct the procedure while the other holds the baby still.

- **Provide on-the-job training of nurses who were not technically skilled in conducting X-ray examinations:** By working with more experienced staff, nurses learned how to position the baby and how to use the personal protective and X-ray equipment. Later, all the staff nurses received a formal, one-day training by a radiography technician on how to take an X-ray film.

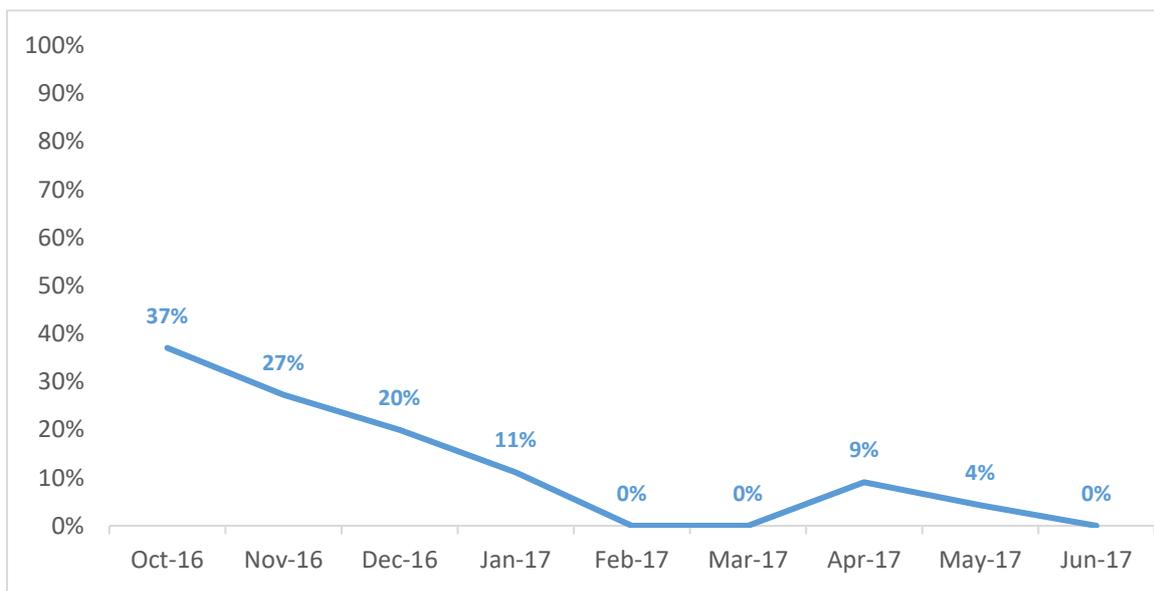
#### How the team reduced X-rays done to locate the tip of UVC/UAC cannulas:

- **Use of point of care ultrasonography to locate the tip of UVC/AVC:** Staff in the NICU also used X-rays to locate the tip of the UVC/UAC in babies when this was required. It was routinely used because it was possible to do in the absence of neonatologists. The team discussed with neonatologists using point-of-care ultrasonography when they were present in the facility. They decided to switch to the easier, faster, and more cost-effective method of point-of-care ultrasonography. The neonatologist tested the idea on one baby; it worked as well as using X-rays, so they made this unit policy.

### Results

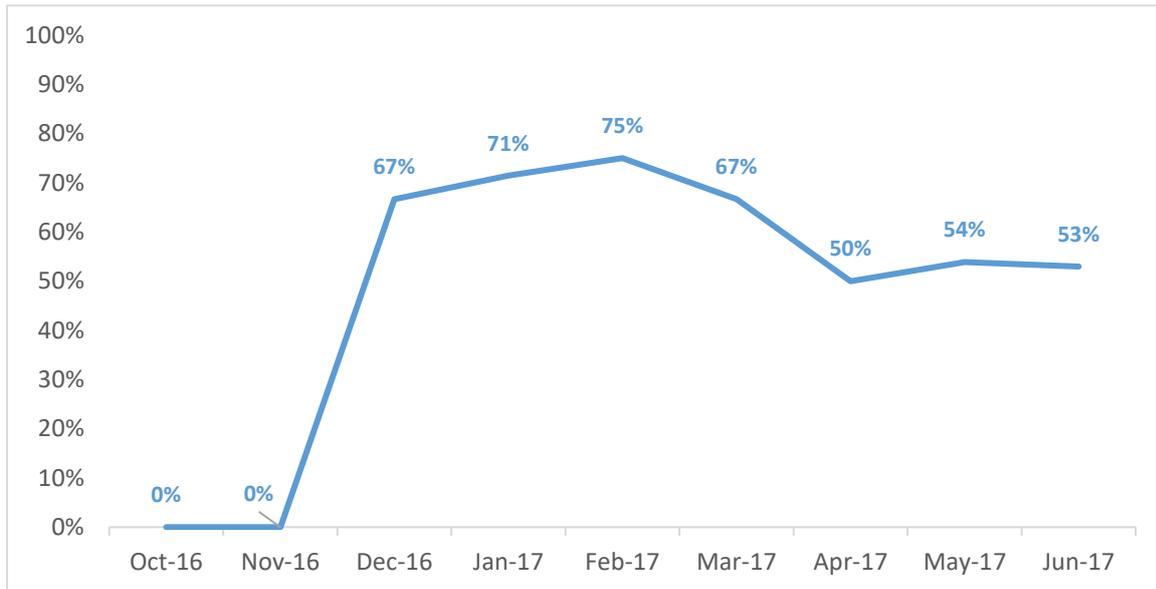
At baseline in October 2016, 37% of babies were exposed to duplicate X-rays; by February 2017, this had decreased to 0% (see **Figure 1**). Some X-rays had to be repeated in April and May due to the image being contaminated by artefacts, like jewellery, but no X-rays had to be repeated due to poor image quality between February and June.

**Figure 1. Percentage of babies with duplicate X-ray performed**



The percentage of UVC/UAC tips being located using ultrasonography, and therefore not requiring X-ray examination, increased from 0% in October 2016 to 67% in December 2016 and has been sustained at that level since then (see **Figure 2**). The team was not able to completely eliminate the use of X-rays to locate the tip of the UVC/UAC because the neonatologists trained in doing the ultrasonography were sometimes not available, and so facility staff would have to locate the tip by X-ray examination instead.

**Figure 2. Percentage of babies for whom ultrasonography was performed to locate the tip of catheter instead of X-ray**



By utilizing the available human resources and modifying the existing process of taking X-ray film, the team avoided exposing 239 infants to unnecessary X-ray examinations and the resulting radiation exposure. In addition to preventing radiation exposure (210 babies who did not have repeated X-ray examination and 29 who did not have X-ray examination for locating the tip of UVC/UAC cannula), this quality improvement effort led to a savings to the parents of Rs 445 (USD \$7.41) per baby requiring a diagnostic X-ray and Rs 254 (USD \$4.23) per baby requiring a UVC/UAC. Given that the average daily income in India is Rs 448 (USD \$7.46), this saves a considerable sum for most families.

### **Conclusion**

This improvement project is a pioneering effort by a private institution in India to reduce X-ray exposure to babies and contain medical costs using QI methods. The hospital is now using improvement approaches to address other problems.

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