NEO FOR NAMIBIA
HELPING BABIES SURVIVE

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MISSION REPORT

Mission 2019-2

June 4 to 26, 2019

NEO FOR NAMIBIA
HELPING BABIES SURVIVE

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DESIGN mesch.ch

1. INTRODUCTION

The 8th mission of NEO FOR NAMIBIA – Helping Babies Survive lasted from June 4–26, 2019; unpredictable last minute "turbulences" required some flexibility. Because the Air Namibia flight from Frankfurt to Windhoek was cancelled, an alternative route with Ethiopian Airlines via Addis Abeba had to be chosen. As a consequence, the connecting flight from Windhoek to Rundu was missed, and Prof. Berger and Brenton Titus eventually reached Rundu after a 10-hour drive with the NEO FOR NAMIBIA Toyota Hilux (Fig. 1).

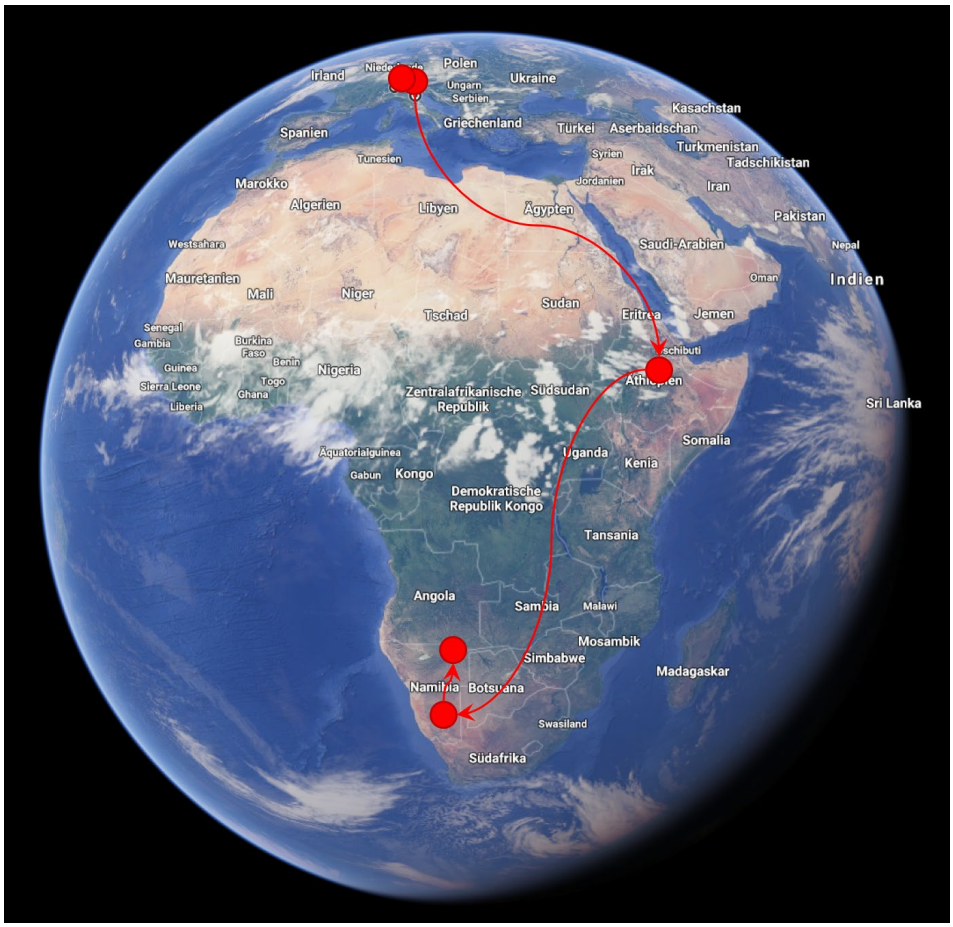

Fig. 1. Having missed the connecting flight from Windhoek to Rundu, Prof. Berger and Brenton Titus had to drive more than 700 km to reach Rundu shortly before midnight.

This time, Prof. Berger had to carry out the mission without the help of his wife, pediatric nurse Sabine Berger (Fig. 2); a family medical emergency did not allow her to leave Switzerland. However, during the 3rd week of his stay in Rundu, Elena Bosio joined and supported Prof. Berger. A food engineer by training, she became interested in the work of NEO FOR NAMIBIA following a presentation by Prof. Berger at the Rotary Club in Lugano, Switzerland.

Fig. 2. On the way to work: in June, during the Namibian winter, the sun rises shortly after 7 o'clock, and the temperature increases rapidly from around 6°C to more than 20°C, eventually reaching 28–30°C in the afternoon.

As requested by the local health care professionals, we planned to introduce new pieces of equipment to enable them to provide rescue invasive mechanical ventilation to selected patients. This included a transport/ICU ventilator, a heater/humidifier and a video laryngoscope.

On Monday, June 23, 2019, Prof. Berger had the opportunity to discuss future efforts of NEO FOR NAMIBIA with the former Health Minister, Dr. Bernard Haufiku and the Permanent Secretary (PS)/Executive Director (ED) Dr. Ben T. Nangombe. In addition, he was privileged to meet the Vice President of Namibia, his Excellency Nangolo Mbumba, at the Old State House in Windhoek. It was obvious that the work of NEO FOR NAMIBIA was highly appreciated, and both the PS/ED and the VP promised to support our efforts.

2. MAIN MISSION GOALS

The main mission goals were:

1. To introduce invasive mechanical ventilation at Rundu State Hospital
2. To provide in-depth training in the use of the new equipment
3. To train visitors from Onandjokwe State Hospital
4. To introduce on-line patient registries: the Namibian Minimal Neonatal Data Set (Namibian MNDS), the CPAP patient registry, the Mechanical Ventilation (MV) patient registry
5. To meet the former Health Minister, Dr. Bernard Haufiku and the new Permanent Secretary (PS), now called Executive Director (ED) of the Ministry of Health and Social Services, Dr. Ben T. Nangombe.

3. EQUIPMENT

In the past, doctors and nurses at Rundu State Hospital had repeatedly expressed their frustration about the lack of a mechanical ventilator that could be used as a last resort in desperate situations. CPAP can help many babies, but some require more support, either because their lungs are to sick or, perhaps even more commonly, their respiratory drive is insufficient.

We were initially hesitant to comply with this request because we were afraid that the unit would not yet be ready for this step. However, after having witnessed several situations, where the lives of babies were lost because such a machine was not available, we set out to look for a suitable ventilator.

For several reasons, CPAP must remain the main form of respiratory support for babies with breathing difficulties. It is now a routine procedure in the Prem Unit at Rundu State Hospital (Fig. 3–5) and has been proven beyond doubt to be successful (see 5.1 CPAP patient registry data below). It has saved lives and will save even more lives in the future.

Fig. 3. Supporting babies with respiratory distress using the Pumani® bubble CPAP device has become a routine procedure.

Fig. 4. Term infant on an open warmer supported with bubble CPAP.

Fig. 5. Preterm infant in an incubator supported with bubble CPAP.

Given the lack of compressed air in the Prem Unit at Rundu State Hospital and the limited availability of technical support, a robust turbine-driven transport ventilator was chosen (EVE neo) (Fig. 6). Ideally, invasive mechanical ventilation should include proper heating and humidification of the inspired gas. Therefore, a heater/humidifier and sets of compatible patient tubing were purchased. Arash Tehrani from Anandic Medical Systems (Feuerthalen, Switzerland) and Fritz Stephan GmbH, Gackenbach, Germany, greatly facilitated the procurement of the equipment.

Fig. 6. The EVE neo ventilator (Fritz Stephan GmbH, Germany) was chosen because it is turbine-driven (i.e. independent of compressed air); it can be used across all age groups, including preterm and term infants.

While a mechanical ventilator can undoubtedly save lives, it is also a technology that can cause harm to patients if used inappropriately. It was therefore of paramount importance to provide proper theoretical and practical training to all pediatricians and as many Prem Unit nurses as possible during our stay.

Intubation of critically ill neonates is a high-risk procedure. It can be used in the context of surfactant replacement therapy (so-called INSURE: INtubate SURfactant Extubate) or when invasive mechanical ventilation is needed. It requires adequate preparation, teamwork, and manual skills. Available literature suggests that video-assisted intubation is associated with higher success rates, particularly when experience is limited. We therefore purchased an affordable device (Fig. 7) from Leyte Medical Equipment Company (Gangzhou, China).

Fig. 7. Intubation (insertion of an endotracheal tube (ETT) into the windpipe) requires skills; video laryngoscopy has been shown to increase success rates.

In addition, various consumables (including those needed for POCT (point of care testing) of bilirubin concentrations introduced in February 2019), as well as 5 additional pulse oximeters (3 for Rundu, 2 for Onandjokwe), 10 patient cables and 100 neonatal sensors (60 for Rundu, 40 for Onandjokwe) could be purchased; with this donation, the total number of pulse oximeters donated since the program was started has now reached 19.

It is encouraging to see that the equipment has stood the test of time: all pulse oximeters are in working order. The same can be said about the 11 Pumani® bubble CPAP devices, the 7 Wallaby® warming tables, the 5 Colibri® phototherapy lights and the 11 MTTS LifeKit® infant cot beds.

4. TRAINING

4.1 Visit by team from Onandjokwe

To strengthen the collaboration with the Onandjokwe State Hospital, a team had been invited to join the teaching sessions at Rundu State Hospital. We were happy to once again meet Dr. Joy Shilongo and Selma Usiko, a neonatology nurse. They both worked closely together with the Rundu medical staff and participated in the theoretical and practical teaching sessions (Fig. 8).

Fig. 8. All the pediatricians (including the visiting doctor from Onandjokwe, Dr. Joy Shilongo) received one-on-one training in intubation and invasive mechanical ventilation.

4.2 Formal educational sessions

With the mission's focus on invasive respiratory support, lectures covered the history of neonatal ventilation (to highlight risks and complications), patient selection for invasive mechanical ventilation, adequate preparation for intubation, principles of lung-protective mechanical ventilation and interpretation of blood gas analyses (Fig. 9).

Beatrix Callard, a neonatal nurse practitioner from Windhoek General Hospital, and 4 students from a Master of Child Nursing program from the Red Cross War Memorial Children's Hospital in Cape Town, South Africa, joined us, observed the work in various pediatric wards and gave their input. Their opinions and perspectives were highly welcome. Mrs. Callard gave an excellent talk on "Exit plans", highlighting the importance of anticipation: "If you don't know where you are going, you will not know how to get there."

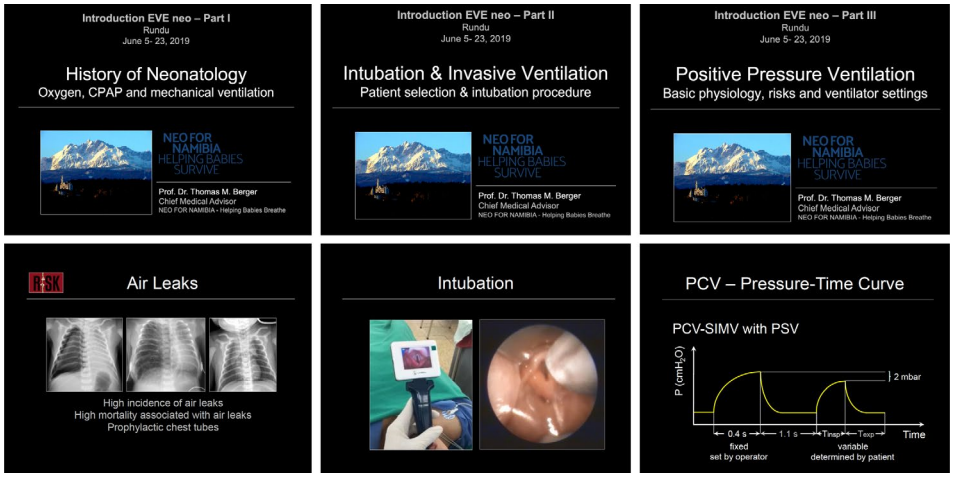

Fig. 9. This time, Prof. Berger's lectures focused on various aspects invasive neonatal respiratory support.

Some of the main teaching points discussed were once again emphasized on laminated reminders (Fig. 10 – 12): patient ventilator tubing assembly, details of the equipment needed for intubation, appropriate endotracheal tube (ETT) size and insertion depth based on the weight of the patient, use of appropriate tidal volumes to avoid volutrauma, and the concept of permissive hypercapnia. The latter is particularly challenging since blood gas analyses are currently not available. Apparently, a machine should become available in the near future but very likely will not be adapted to neonates (i.e., require large sample volumes).

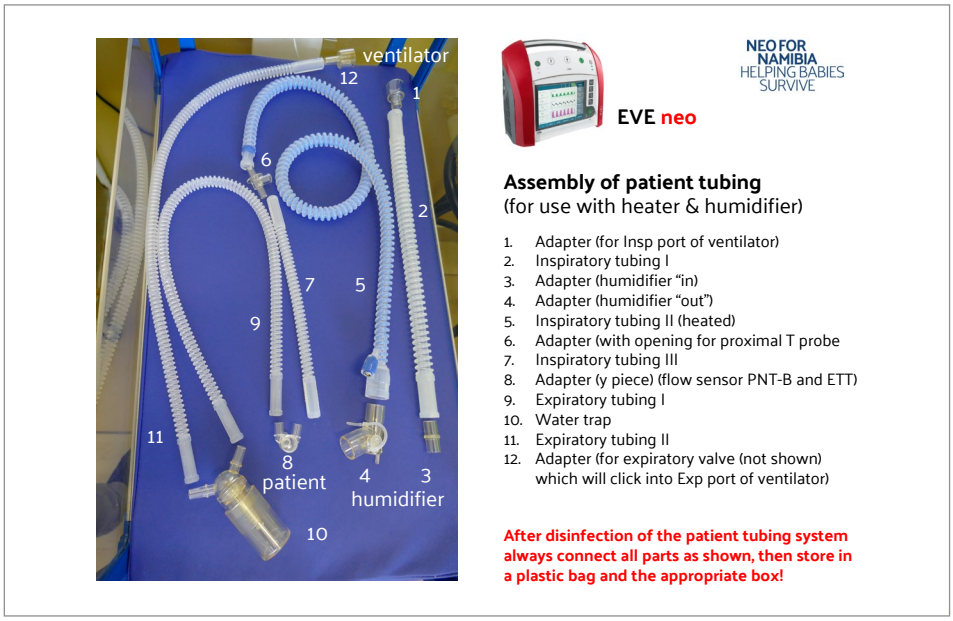

Fig. 10. Careful preparation and handling of the new equipment is of paramount importance.

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EQUIPMENT FOR INTUBATION

1. IV access
2. Drugs (morphine or fentanyl)
3. Ambu® bag
4. Oxygen
5. Suction
6. Laryngoscope (Miller blades 0 and 1)
7. Endotracheal tube (2 sizes)
8. Stylet (OT intubation)
9. NG tube (NT intubation)
10. Stethoscope
11. Pre-cut tape and suture for fixation

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ETT size and insertion depth

	1000 g	2000 g	3000 g	4000 g
Size				
ETT ID	2.5	3.0	3.5	3.5
Insertion depth				
OT intubation (BW(kg)+6)	7	8	9	10
NT intubation (+20%)	8.5	9.5	11	12

Fig. 11. Proper preparation, use of a (video) laryngoscope and selection of adequate ETT size and insertion depth are cornerstones for safe intubation.

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ADJUST THE **PINSP** TO ACHIEVE A **TIDAL VOLUME (TV)** **4-6 ml/kg**

REMEMBER: TV = (Pinsp-PEEP) · COMPLIANCE

ALSO ADJUST ΔPSUPP OF PSV

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TIDAL VOLUME GOALS

REMEMBER: TV = (PINSP-PEEP) C (4-6 ml/kg)

Birth weight	4 ml/kg	5 ml/kg	6 ml/kg
1000 g	4 ml	**5 ml**	6 ml
1500 g	6 ml	**7.5 ml**	9 ml
2000 g	8 ml	**10 ml**	12 ml
2500 g	10 ml	**12.5 ml**	15 ml
3000 g	12 ml	**15 ml**	18 ml
3500 g	14 ml	**17.5 ml**	21 ml
4000 g	16 ml	**20 ml**	24 ml
4500 g	18 ml	**22.5 ml**	27 ml

Fig. 12. Targeting and monitoring weight-adjusted tidal volumes are essential to prevent harm from invasive mechanical ventilation.

4.3 Bedside teaching

4.3.1 Intubation

The use of the new video laryngoscope could be taught on several occasions. The doctors were instructed both on orotracheal intubation facilitated by the use of a stylet (for the INSURE procedure) and nasotracheal intubation facilitated by the use of an NG tube (for more prolonged mechanical ventilation).

Intubation without any premedication can be very challenging, particularly when babies are fully awake and struggling to breathe. At least for semi-elective intubations, short-acting analgesic and / or sedative drugs should be made available.

4.3.2 Mechanical ventilation

The new ventilator was placed into the procedure room of the Prem Unit (Fig. 13). It was wall-mounted, and space was created to place the humidifier so that it can be used for infants on an open warmer, as well as for infants in an incubator. Oxygen can be obtained from a wall outlet or, as a back-up, from an oxygen cylinder (Dölf Felder, medical technician at the Zuger Kantonsspital, had organized an appropriate adapter).

At least initially, it is planned that a nurse must be present in this room whenever a patient is put on mechanical ventilation. Alarms from the machine must be addressed immediately.

Fig. 13. The EVE neo ventilator was installed in the treatment room of the Prem Unit.

At the end of the second week, outborn twins with an estimated gestational age of 32 weeks were admitted to the Prem Unit early in the morning. They were both hypothermic (T 34.5°C) and in severe respiratory distress. Twin A had to be resuscitated on arrival (including chest compressions) and continued to have poor oxygen saturations (70–75 %) on CPAP with an FiO_2 of 100 %; twin B was more stable.

Twin A was intubated (no premedication available, on 3rd attempt), surfactant was administered, and she was put on the EVE neo ventilator. She stabilized on the following ventilator settings (PC-SIMV with PS): Pinsp 22 mbar, PEEP 5 mbar, rate 40 breaths per minute, FiO_2 100 % (gradually weaned to 60 %), PSUPP 15 mbar above PEEP. Rapid weaning was not possible, therefore, the baby was sedated with morphine and kept on the ventilator over night (Fig. 14). Her twin sister was treated with INSURE and remained stable on CPAP.

Fig. 14. Nurse Cecilia Ndepavali taking care of the first patient at Rundu State Hospital on the new EVE neo ventilator.

After 24 hours, the little girl could be extubated and was put on CPAP (Fig. 15). Three days later, she was weaned off CPAP (Fig. 16), and, finally, at the age of 4 weeks she was discharged home together with her twin sister (Fig. 17).

Fig. 15. After 24 hours, twin A could be extubated and transitioned to CPAP.

Fig. 16. Twin A weaned off both CPAP and nasal cannula oxygen: a feeder & grower.

Fig. 17. Finally, the first baby that has ever been mechanically ventilated at Rundu State Hospital can go home – together with her twin sister.

5. IMPACT ANALYSIS – UPDATE

5.1 CPAP registry data

By the end of June 2019, 259 patients had been treated with Pumani® bubble CPAP devices, totaling 915 CPAP days (Fig. 18). The survival rate was 71 % (140 / 198) and 85 % (52 / 61) at Rundu State Hospital and Onandjokwe State Hospital, respectively. A likely explanation for the observed difference in survival rates between the two hospitals is the fact that patients who fail CPAP support can be treated with invasive mechanical ventilation in Onandjokwe; this option has only now become available in Rundu.

This data shows that many more patients can potentially be saved in Namibia if similar changes would be implemented in other hospitals that care for sick neonates. With the help of the Ministry of Health and Social Services (MHSS), NEO FOR NAMIBIA – Helping Babies Survive will support all efforts in that direction.

CPAP registry data – August 2017 to June 2019

Total number of patients recorded	259
Median birth weight, g (range)	1690 (600 – 4700)
CPAP days (median, range)	915 (3, 1 – 20)
Survival rate	74% (n = 192)

Fig. 18. CPAP registry data (August 2017 to October 2018: Rundu only; November 2018 to June 2019: Rundu and Onandjokwe): the overall survival rate of infants requiring CPAP support has reached 74 %.

5.2 Prem Unit statistics

Prior to November 2018, no outborn babies had been admitted to the Prem Unit because of infectious disease concerns. However, the Pediatric and High Care Wards were neither staffed nor equipped well enough to care for such patients, and, therefore, this policy was changed. Unfortunately, detailed statistics for these patients from the past are not available.

From January 1, 2019 to June 23, 2019, a total of 228 patients had been admitted to the Prem Unit. Inborn and outborn infants accounted for 83.5 % and 16.5 % of all admissions, respectively. During the same time period, there were 29 deaths resulting in an overall mortality rate of 10.6 %. When analyzed separately, the mortality rate of inborn patients was 7.5 % (down from an average of 14.7 % in the years 2012 to 2015, and comparable to the 8.6 % in 2017), indicating sustained success of our interventions.

The mortality rate of outborn infants was significantly higher: 12 of the 45 infants admitted after home delivery or from other health centers died (mortality rate 26.7 %). Therefore, when compared with inborn infants, outborn babies had a mortality rate that was 3.6 times higher (Fig. 19). Late referrals, inadequate initial stabilization and long transport distances are the main reasons for this finding. There is an urgent need to improve centralization of high-risk pregnancies and advanced neonatal care.

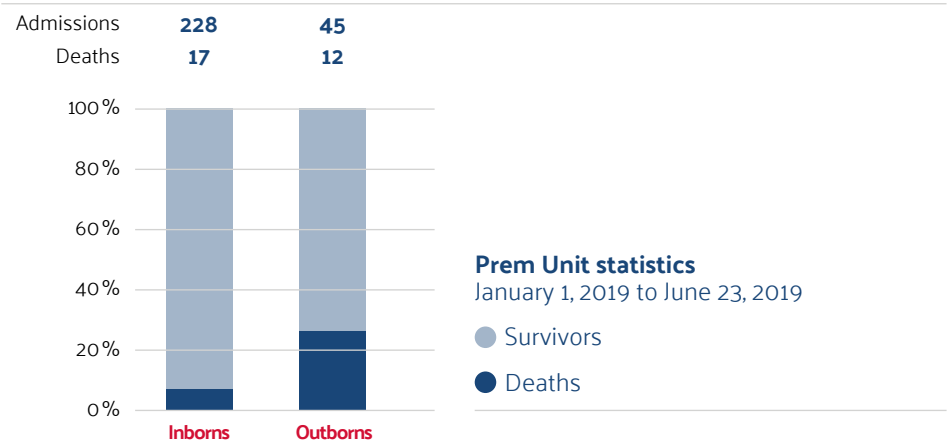

Fig. 19. Prem Unit statistics January 1, 2019 to June 23, 2019: improved mortality rates of inborn infants have been sustained; in contrast, mortality rates of outborn infants are very high.

5.3 On-line registries

As pointed out in earlier mission reports, more reliable statistical data must be collected to better understand the scope of the various challenges. Deaths should be analyzed in more detail so that potential strategies can be developed to prevent at least some of these deaths.

Three different on-line registries have been developed (Fig. 23): a) the Namibian Minimal Neonatal Data Set (Namibian MNDS), b) the CPAP patient registry and c) the Mechanical Ventilation (MV) patient registry. Three doctors have been identified who will be responsible for data entry (Rundu State Hospital: Dr. Mapanga, Dr. Ashipala; Onandjokwe State Hospital: Dr. Shilongo). Data capture started on July 1, 2019. A first interim analysis will be done prior to the next mission in November / December 2019.

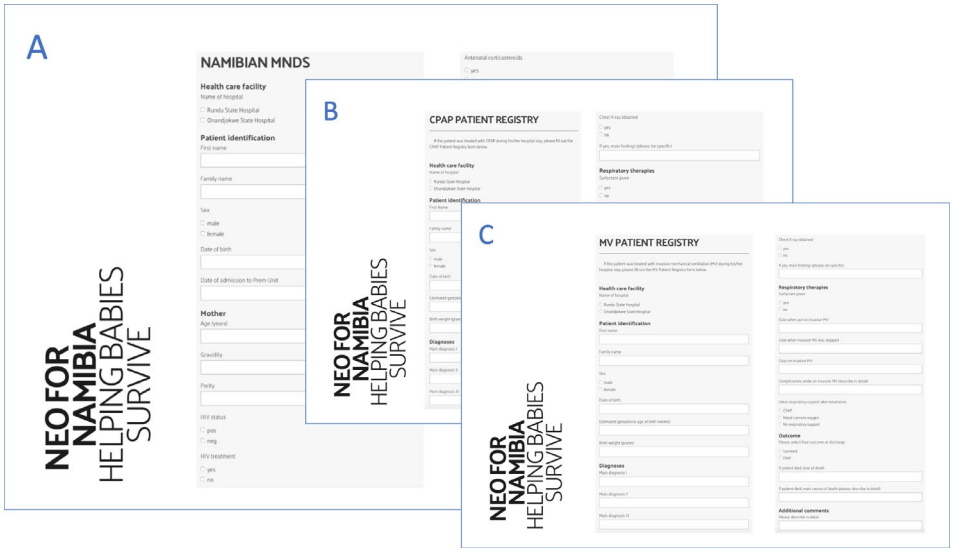

Fig. 20. Starting on July 1, 2019, uniform data will be collected on all patients admitted to the neonatal units at both Rundu and Onandjokwe State Hospitals.

6. ONGOING CHALLENGES

While significant progress has been achieved over the last two years, some challenges have persisted and must be addressed.

6.1 Supply chains

Supply chains remain unreliable: the term "out of stock" is commonly used in this context and accepted as a definitive answer. During our stay, antibiotics (vancomycin, meropenem), caffeine, diapers and formula milk were at times unavailable (of interest, the latter three could be obtained from the public pharmacy in town within 24 hours).

6.2 Nosocomial infections

Nosocomial infections appear to be common, and antibiotics must be used without any information on the causative organisms since bacterial cultures and sensitivities are not available. The performance of the hospital's laboratory (Namibia Institute of Pathology) remains substandard: blood samples get lost (or clot), results are only available with considerable delays, and critical values are not reported verbally. Since treatment decisions are often based on laboratory results (e.g., CRP values, bilirubin concentrations), inacceptable delays put babies at increased risks.

6.3 Nutrition

Parenteral nutrition and central venous access other than through the umbilical vein are not available. Not surprisingly, postnatal growth failure among very low birth weight infants is very common (with the new Namibian MNDS, we will be able to quantify this phenomenon more precisely). Feeding intolerance is prevalent, and the local doctors and nurses have started to attempt 2-hrly feeds instead of 3-hrly feeds in such infants.

Another strategy to address this problem might be to start fortification with FM85 before full feeds are reached (e.g., at a daily enteral intake of 100 ml / kg). This would have to be at least 10 ml per feed because half a spoon of FM85 is equivalent to 0.5 g (usually, fortification is achieved by adding 5 g to 100 ml to bring the caloric density of mother's milk from 67 kcal / 100 ml to 85 kcal / 100 ml).

Some babies require IV access for long periods of time and maintaining access becomes increasingly difficult. Peripherally inserted central catheters (PICCs) are not available. Such catheters are expensive and can be dangerous if sterile precautions cannot be followed at all times; nevertheless, occasionally such access could be life-saving.

6.4 New Maternity and Prem Unit

The new unit has still not opened. At meetings with government officials we pointed out that NEO FOR NAMIBIA – Helping Babies Survive and the health care staff at Rundu State Hospital have done their job. Now the time has come for the MHSS to contribute their part.

At the meeting with the PS/ED Dr. Ben T. Nangombe, Prof. Berger was informed that legal issues have been resolved and, hopefully, the new building will open within the next 6 months. The Vice President of Namibia, his Excellency Nangolo Mbumba, also supported this effort. During a visit to the Kavango region two days after meeting Prof. Berger and Dr. Haufiku in his office, he met with the leaders at Rundu State Hospital and declared the completion of the new unit a priority (Fig. 24).

NEW ERA LIVE

VP orders health to finish delayed maternity ward

JOHN MUYAMBA HEALTH KAVANGO EAST

June 28, 2019

RUNDU - Vice President (VP) Nangolo Mbumba wants the ministry of health, the Rundu hospitals leadership and the contractor to work together to finalise the new Rundu maternity ward.

"The hospital cannot continue to accommodate mothers and newborns on the hospital corridors. This is our hospital and the main thing left here is that the theatre setup must be completed to be operational, because we have patients there sleeping on the floor, on mattresses and in corridors, that we can't afford," noted the VP who is on a working tour of the two Kavango regions.

Fig. 21. His Excellency, Vice President Nangolo Mbumba visiting the maternity ward at Rundu State Hospital (Source: New Era newspaper report June 28, 2019).

7. VERY SPECIAL PATIENTS

7.1 Nicoteh

We were delighted to meet Nicoteh and her mother once again. The former very low birth weight infant (birth weight 1150 g) has fully recovered from complications related to prematurity and is obviously thriving (Fig. 25).

Fig. 22. Elena Bosio meeting Nicoteh and her mother in front of the Prem Unit.

7.2 Diaphragmatic hernia

This infant was born with a birth weight of 1600 g and developed respiratory distress soon after delivery. Following the insertion of an NG tube and an umbilical venous catheter, a babygram was obtained. Given the moderate degree of respiratory distress, everybody was surprised to see that this baby had congenital diaphragmatic hernia (CDH) (Fig. 23). The baby was transferred to Windhoek the next day in a stable condition. If at all, surgery will only be available at a private hospital.

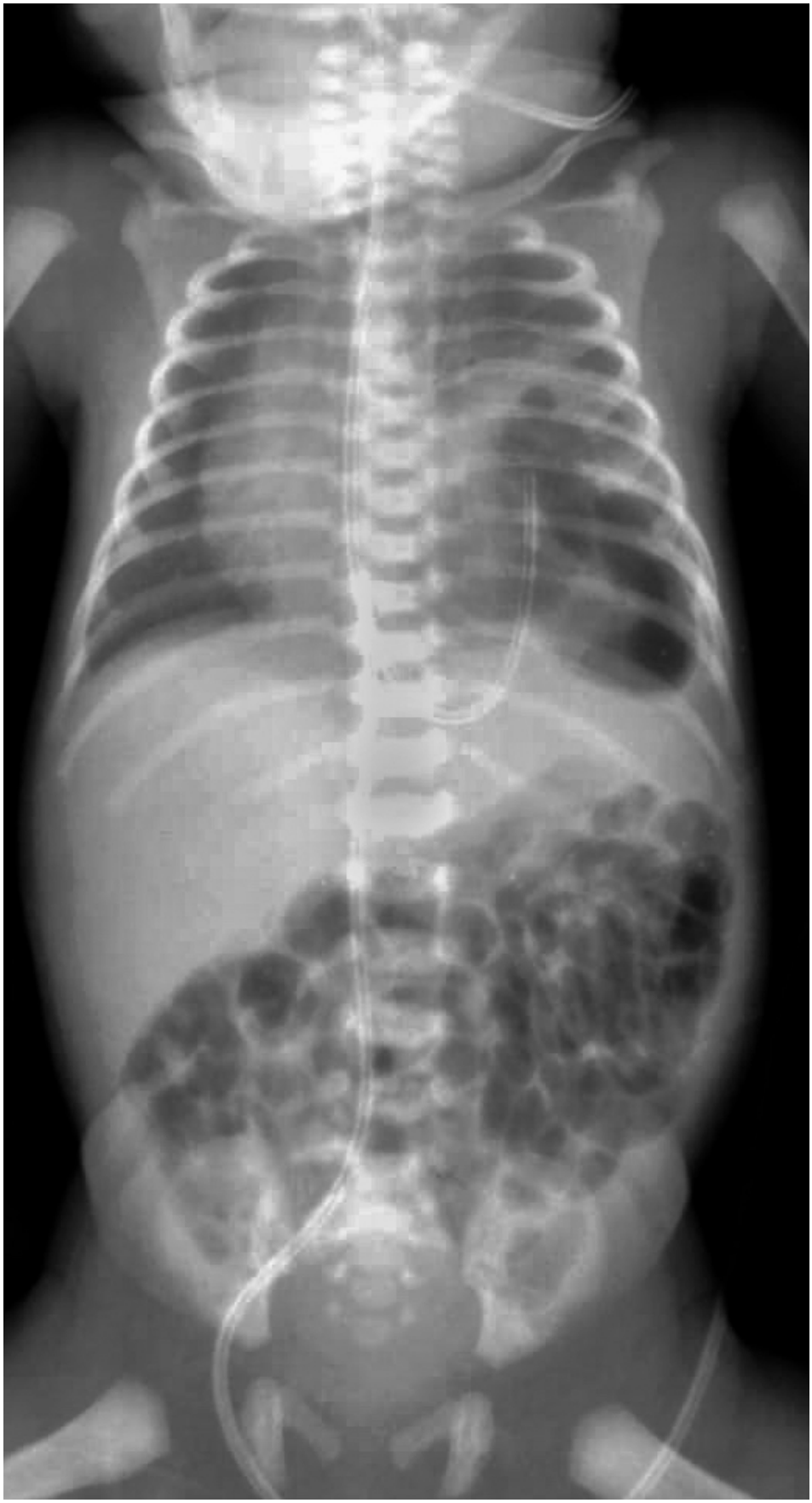

Fig. 23. Babygram of a preterm baby with mild respiratory distress: X-ray findings suggest a left-sided congenital diaphragmatic hernia.

7.3 Esophageal atresia

This baby was born with a birth weight of 1150 g to a HIV-positive mother who has not been on any antiretroviral therapy (high risk for mother-to-child transmission). The baby was noted to have foamy secretions draining from its mouth, and when an orogastric tube could not be passed into the stomach, esophageal atresia was suspected. This was confirmed on a babygram (Fig. 24).

Unfortunately, PMTCT (prevention of mother to child transmission) of HIV was not feasible since no IV drugs for this purpose were available. The infant was stabilized, weaned off CPAP and transferred to Windhoek. Again, surgery for this small baby will only be possible at a private hospital (if at all...).

Fig. 23. Preterm infant with esophageal atresia (EA) and trachea-esophageal fistula (TEF); note foamy secretions at the lips (left). An orogastric tube could not be advanced and became lodged in the upper esophageal pouch (arrow head); air in the gastrointestinal tract proves that there must be a TEF (right).

7.4 Myelomeningocele

In addition to the above-mentioned babies with CDH, EA with TEF, and another patient with suspected jejunal atresia (not shown), a near-term baby with myelomeningocele (Fig. 28) was transferred to Windhoek. Apparently, surgery will only be done at the age of 3 months unless a cerebrospinal fluid leak occurs earlier.

Fig. 24. Near-term infant with myelomeningocele.

8. FUTURE DIRECTIONS

8.1 Mission 2019-3

We plan to return to Namibia in November 2019 for our 9th mission. Once again, we will spend most of our time at Rundu State Hospital. We hope that we will find that work for the new Maternity and Prem Units is progressing well; if so, additional equipment (particularly open warmers and cot beds) will be needed.

It is possible that we will assess the neonatology services of an additional hospital to see whether these sites would be suitable candidates for our program. We are currently awaiting feed-back from the MHSS.

8.2 Namibian Minimal Neonatal Data Set (Namibian MNDS), CPAP and MV patient registries

The coming months will show whether better patient data can be reliably recorded. We will discuss the results of preliminary analyses with our Namibian colleagues. It is conceivable that adjustments will be necessary to improve data quality. Hopefully, a more comprehensive understanding of morbidity and mortality rates (including specific diagnoses, as well as causes and circumstances of deaths) will help us to improve our interventions.

8.3 Fundraising efforts

Thus far, NEO FOR NAMIBIA – Helping Babies Survive has raised more than CHF 200'000.00. Most of this money was invested directly to support hospitals in the northern region of Namibia. The overhead of our NGO is minimal, and the team members of NEO FOR NAMIBIA work on a voluntary basis. The efficacy of the interventions has been proven beyond doubt. Despite the relatively low cost, the selected pieces of equipment have been shown to be reliable and robust. As the program expands, more equipment will have to be purchased, and fundraising efforts remain extremely important.

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