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Training a neonatal health care work force in a low-resource setting in Sub-Saharan Africa

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Abstract: The 2016 World Health Organisation (WHO) bottleneck analysis for newborn care highlighted Zambia's limited healthcare workforce specifically trained to care for small and sick neonates. This skills-constraint contribute to the country's high neonatal mortality rate (NMR) and are limiting efforts to achieve the Sustainable Development Goal (SDG) NMR target of less than 12/1000 live births by 2030.
In 2020, a one-year skills-based postgraduate diploma (PGDip) in neonatology was introduced under the auspices of the Zambia College of Medicine and Surgery (ZACOMS). Nine medical doctors were enrolled in the first year and seven in the second year. An annual programme evaluation was undertaken to assess its strength and weaknesses and inform future training. All sixteen candidates completed the requisite logbook procedures and passed examinations to attain the PGDip in Neonatology. Candidates reported increased confidence in the management of neonatal conditions, which was also reflected in instructor and external evaluations. Trainees have established and taken ownership of a newborn community outreach programme - establishing Kangaroo Mother Care (KMC) units in community-based facilities. These satellite KMC units decongested the Lusaka University Teaching Hospitals- Women and Newborn Hospital, and markedly improved patient experience and quality of care for patients needing advanced neonatal care.
Concurrently introduced neonatal nursing training programmes providing newborn care skills to nursing staff has further improved quality of care on the unit with about 40% reduction in neonatal mortality over the past two years. This article focuses on the establishment and execution of the PGDip in neonatology.

Key words: Neonatology training, competences, low resource countries

Résumé: L'analyse des goulots d'étranglement de l'Organisation mondiale de la santé (OMS) en 2016 pour les soins aux nouveaunés a mis en évidence les limites du personnel de santé en Zambie, spécifiquement formé pour soigner les nouveau-nés de faible poids de naissance et malades. Cette contrainte de compétences contribue au taux de mortalité néonatale (TMN) élevé du pays et limite les efforts pour atteindre l'objectif de développement durable (ODD) de moins de 12/1000

naissances vivantes d'ici 2030.
En 2020, un diplôme de troisième cycle basé sur les compétences (PGDip) d'une durée d'an en néonatologie a été introduit sous les auspices du Collège zambien de médecine et de chirurgie (ZACOMS). Neuf médecins étaient inscrits au cours de la première année et sept au cours de la deuxième année. Une évaluation annuelle du programme a été entreprise pour évaluer ses forces et faiblesses et éclairer la formation future. Les seize candidats ont suivi les procédures de journal de bord requises et ont réussi les examens pour obtenir le PGDip en néonatologie. Les candidats ont signalé une confiance accrue dans la gestion des affections néonatales, ce qui s'est également reflété dans les évaluations des instructeurs et externes. Les stagiaires ont mis en place et pris en charge un programme de sensibilisation communautaire des nouveau-nés établissant des unités de soins maternels kangourou (KMC) dans des établissements communautaires. Ces unités KMC satellites ont décongestionné les hôpitaux universitaires de Lusaka - hôpital pour femmes et nouveau-nés, et ont nettement amélioré l'expérience des patients et la qualité des soins pour les patients nécessitant des soins néonatals avancés.
La mise en place simultanée de programmes de formation en soins infirmiers néonatals offrant des compétences en soins néonatals au personnel infirmier a encore amélioré la qualité des soins dans l'unité avec une réduction d'environ 40 % de la mortalité néonatale au cours des deux dernières années. Cet article souligne lerôle important de la mise en place et de l'exécution du PGDip en néonatologie.

Mots clés: Formation en néonatologie, compétences, pays à faibles ressources.

Introduction

Neonatal (infants < 28 days, newborn) mortality is unacceptably high in low-resource settings. Countries in sub-Saharan Africa have the highest mortality rates[1-3] largely due to the limited availability of resources and skilled healthcare providers to address the leading causes of death in the first month of life.[4-6]

Strengthening facility-based care of newborns is one of the most effective approaches of saving newborn lives.[7]The World Health Organization (WHO) identified that inpatient care for neonates, particularly those who are small and sick , should be available 24 hours a day, delivered by a multidisciplinary team of healthcare providers with specialised skills in newborn care.[8]
According to the WHO bottleneck analysis, a tool designed to synthesize and grade health system obstacles to the success of maternal-newborn intervention packages, inadequate infrastructure, equipment and training in the management of small and sick newborns represents a significant barrier to provision of appropriate newborn care.[8]

Zambia has critically low numbers of neonatal units, neonatal nurses, and neonatologists in both the private and public sectors. Although the University of Zambia's postgraduate training programme in general Paediatrics includes some neonatology training, robust specific specialist training programmes for doctors and nurses have not been locally available. Limitations in the number of specialist neonatal programmes available globally further restricts access to training for clinicians in regions with the highest neonatal mortality burden.[9]Scholarship support to pursue neonatal training in other countries is limited, and when available, many African paediatricians opt to migrate to areas with infrastructure that can absorb their newly acquired skills, primarily due to the weak health systems that limit their ability to deliver quality care. [10,11]
Zambia continues to record high rates of neonatal mortality. The 2018 Zambia Demographic Health Survey showed an increase in the neonatal mortality rate to 27 neonatal deaths per 1000 live births in 2017, up from 24 per 1000 live births in 2013.[8,12]As in most low-resource settings, the most common causes of neonatal mortality in Zambia include complications of prematurity, perinatal hypoxia and infections.[4]Many of these conditions are preventable, especially when appropriate early intervention is made.[4]

A number of interventions have been highlighted as being highly effective for reducing the burden of neonatal mortality in LMICs. It is estimated that 71% of neonatal deaths could be averted with increased coverage of these evidence-based interventions, particularly those that have led to improvements in facility-based care. [4,12,13]
Our aim was to develop human resource capacity to address neonatal mortality burden in Zambia. This paper describes our experience in Zambia, of establishing a one-year skills-based PGDip in Neonatology that was introduced under the auspices of the Zambia College of Medicine and Surgery (ZACOMS) Specialty Training Programme (STP), a mother body created by the Ministry of Health to accelerate specialist training in Zambia.
The other two related programmes include a one-year advanced diploma in neonatal nursing to train in-service bedside neonatal nurses (2020) and a two-year Master's programme to train Neonatal Nurse Practitioners (NNP) at the University of Zambia School of Nursing Sciences with technical help of council for International Neonatal Nurses (COINN), commenced in 2021. These are also briefly described in this paper.

Postgraduate diploma in neonatology for medical officers -post internship

The postgraduate training course in neonatology arose from a problem tree analysis of the barriers to reducing neonatal mortality and morbidity in Zambia (Figure 1). This year long postgraduate training programme was created under ZACOMS. The Postgraduate programme was designed based on the South African Diploma in Neonatology, a course supported by the African

Paediatric Fellowship Programme (APFP).[10] The Zambian programme primary aim was to increase the number of doctors with appropriate skills to manage sick and small newborns, in order to reduce neonatal mortality, in keeping with the SDG3 target for achieving a neonatal mortality rate of less than 12/1000 live births by 2030. [3]

A skills-based curriculum prioritizing life-saving neonatal interventions was developed in consultation with stakeholders and delivered in the Neonatology Unit of the University Teaching Hospital's (UTH) Women and Newborn Hospital (WNH). The WNH Neonatal Unit is the nation's largest neonatology referral unit, with both inborn neonates and outborn transfers from all parts of the country. Between 2018 and 2020, WNH conducted an average of 10, 777 deliveries a year, and received an average of 4975 NICU admissions per year. Although initially built to house 40 to 60 babies, the unit accommodates about 80 to 100 babies at any given time. There are 4 NICU beds where invasive ventilation is possible and approximately 25 bassinets used to provide Continuous Positive Airway Pressure (CPAP). The Kangaroo Mother Care (KMC) ward accommodates 26 mother-baby dyads.

WNH has its own laboratory facilities with shared access to radiology and paediatric surgery through its affiliation with the UTH Adult and Children's Hospitals.

Programme recruitment and enrolment: An enrolment target of ten trainees per annum was set for the PGDip in Neonatology. Doctors who had completed 18 months of supervised internship after graduation from medical school were targeted. Candidates enrolled in the training programme through the Office of the ZACOMS Registrar after an advert on national television. No pre-entry interviews were conducted. An enrolment fee of United States Dollars (USD)100 for Zambian students was levied to offset the cost of administering ZACOMS exams.

Programme faculty: The conveners of the training programme were a Consultant Neonatologist and a Consultant Paediatrician. Other faculty included a Paediatric Cardiologist, Obstetricians, Paediatric Surgeons, and a Consultant Immunologist, as well as offsite consultants who conducted lectures virtually. The faculty were expected to give lectures on topics in neonatology; conduct bedside teaching and provide demonstrations of clinical procedures; moderate candidate presentations; and conduct continuous assessment.

Course structure: The course was primarily structured as a 12-month apprenticeship, with trainees attached full time as senior house officers in the WNH Neonatal Unit for the duration of the training period. Candidates were expected to take part in all ward activities.

Table 1: Candidate activities

- Participation in morning hand-over meetings and departmental mortality audits
- Conducting daily ward rounds, independently, and in conjunction with paediatric/obstetrics registrars and consultants on the unit
- Providing ward cover during the day and overnight calls; receiving and delivering appropriate handover to optimize patient management
- Participating in obstetric theatre calls to attend deliveries, particularly for high risk pregnancies
- Participation in the provincial and national Maternal and Perinatal Death Surveillance Reviews (MPDSR)

Course structure prioritized the acquisition of neonatal life-saving skills through faculty/peer-supervised demonstration and practice of clinical assessments and procedures, supplemented by a combination of didactic lectures, bedside teaching, and clinical presentations. As candidates improved in skill and confidence, they also participated in teaching activities for other undergraduate and postgraduate students. They were also involved in the provision of community newborn care and mentorship of staff in the referral facilities in the care of newborns.

Table 2: Skills taught

- Fundamentals of neonatal assessment and triage
- Post-delivery care and basic neonatal resuscitation
- Advanced neonatal resuscitation, including endotracheal intubation and umbilical catheterisation
- Administration of surfactant
- Assembly of CPAP equipment, putting a baby on CPAP, escalation and weaning of a baby off CPAP
- Connection of ventilator circuits, conventional ventilation and interpretation of arterial blood gas results
- Nesting (creating artificial boundaries around the baby to allow for positioning and neuromuscular development)
- Neonatal feeding

Assessment of progress was determined using logbook review, internally proctored quarterly continuous assessments, and end-of-year examinations administered by ZACOMS. The students had a structured test as multiple-choice questions or a written assignment or a quiz once in 3 months. The final examinations included an online multiple choice question examination as well as Objective Structured Clinical Examination (OSCEs) conducted on the ward to assess hands-on practical skills.

Outcomes of implementing the postgraduate training *programme*

Candidate outcomes

The initial training period was from February to December 2020. Out of the projected 10, a cadre of nine all-female candidates aged between 25 and 40 years old were recruited to the course. Eight of the nine doctors enrolled in the first cohort were government-employed

Zambian doctors who remained on their government salaries during the programme. The 9th candidate was a supernumerary registrar from Uganda.

The second year of the programme commenced in January 2021. This cohort consisted of nine all-female candidates, all of whom were Zambian doctors on Government payroll. Two of the nine withdrew from the programme to pursue studies abroad on scholarship, with stated intentions to return. The remaining seven candidates completed and satisfied all requirements for conferral of the PGDip in Neonatology.

Table 3: Profiles and outcomes of the 2020 Cohort

	Origin	Level	Post training
1	Kabwe General Hospital (Central Province)	Medical officer practicing for at least 5 years	Returned to original station to help set up a functional neonatal unit
2.	Lusaka Fertility clinic	Senior Resident Medical Officer	Returned to set up neonatal ICU
3.	University Teaching Hospital	Post internship	Joined the MMed Paediatrics & Child Health at UTH Children's Hospital
4.	University Teaching Hospital	Post internship	Joined the MMed Paediatrics & Child Health. at UTH. Children's Hospital
5.	University Teaching Hospital	Post internship	Coordinating neonatal activities in the district, spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students Retained on the unit to help with teaching students attached to the NICU
6,	University Teaching Hospital	Medical officer practicing for at least 5 years	Coordinating neonatal activities in the district, spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students Retained on the unit to help with teaching students attached to the NICU
7.	University Teaching Hospital	Post internship	Coordinating neonatal activities in the district, spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students Retained on the unit to help with teaching students attached to the NICU
8.	University Teaching Hospital	Senior resident medical officer	Coordinating neonatal activities in the district, spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students Retained on the unit to help with teaching students attached to the NICU
9.	University Teaching Hospital	Senior resident medical officer	Coordinating neonatal activities in the district, spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students Retained on the unit to help with teaching students attached to the NICU

Evaluation of the specialist training programme in Neonatology

In order, to assess and improve the programme, a formal course evaluation was undertaken at the end of each academic year. Components of the evaluation included:

Individually completed anonymous surveys from all candidates who completed the diploma.

A focus group discussion (FGD) conducted with a subset of diploma candidates, moderated by a member of ZPA (first year), and an APFP-affiliated consultant neonatologist (second year), who had not been involved in the diploma training.

These evaluation tools and a faculty review of programme activities, outcomes, opportunities, and obstacles informed recommendations for the improvement of the diploma and development of future training programmes.

The process of programme design, implementation and evaluation are illustrated in Figures 1 (problem tree), 2 (Objective tree) and 3 (activity flow plan).

Table 4: Profiles and outcomes of the 2021 Cohort of students

	Origin	Level	Post training
1	Liteta District Hospital (Central Province)	Medical officer	Joined the MMedPaediatrics& Child Health at UTH Children's Hospital
2.	Monze Mission Hospital (Southern Province)	Senior Resident Medical Officer	Returned to set up neonatal ICU at Monze Mission Hospital
3.	University Teaching Hospital	Post internship	Joined the MMedPaediatrics& Child Health at UTH Children's Hospital
4.	University Teaching Hospital	Post internship	Joined the MMedPaediatrics& Child Health. at UTH. Children's Hospital
5.	University Teaching Hospital	Post internship	Coordinating neonatal activities in the district- spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students
6.	University Teaching Hospital	Post Internship	Coordinating neonatal activities in the district- spearheading Community KMC Participates in Provincial and National MPDSR meetings. Providing senior cover for interns and the new post graduate diploma students
7.	University Teaching Hospital	Post MMed in Paediatrics and Child Health	Retained on the unit as a Consultant Paediatrician Sponsored by APFP to study Neonatology in 2023 at the University of Cape Town

Fig 1: Problem tree

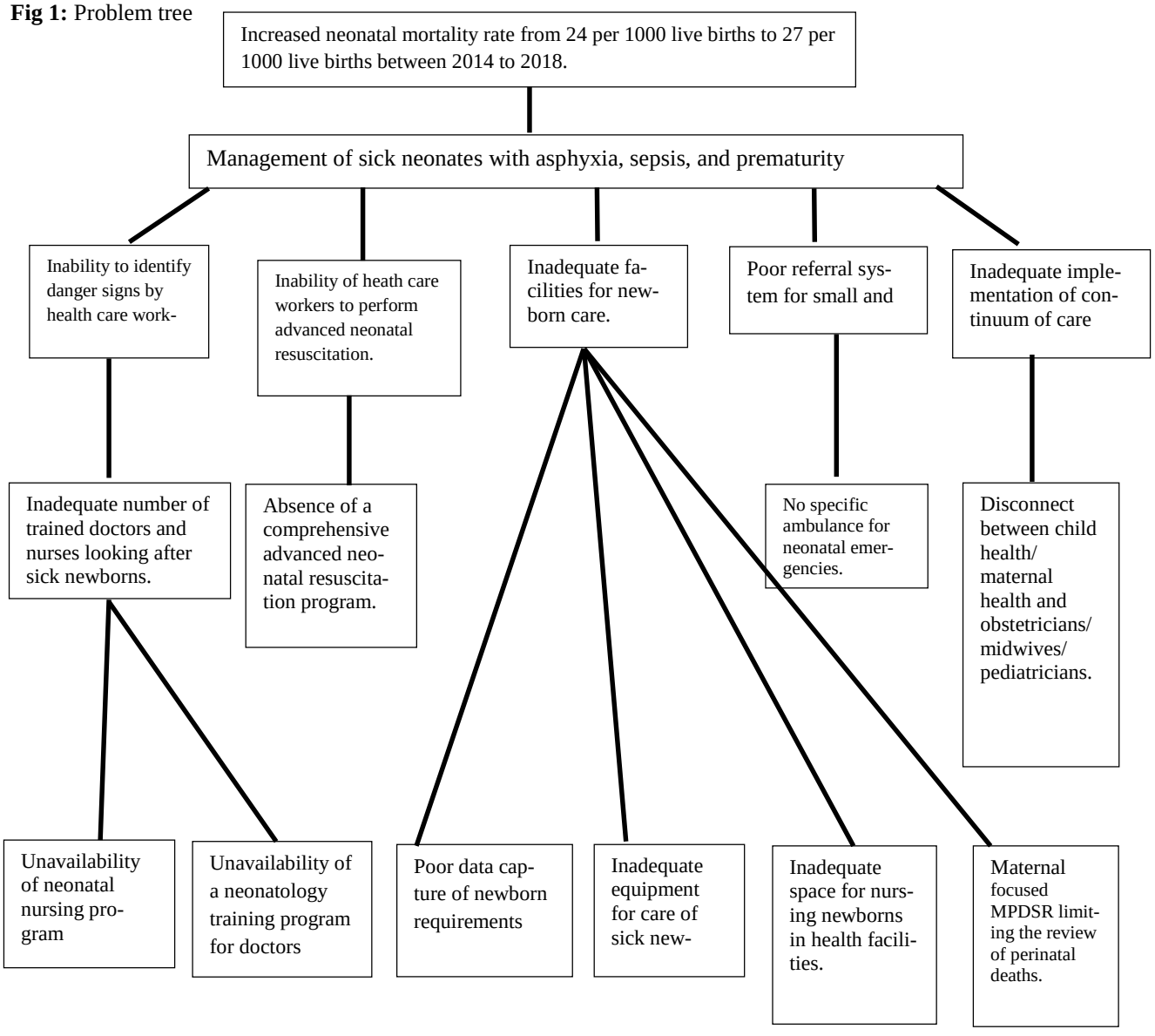


Fig 2: Objective tree

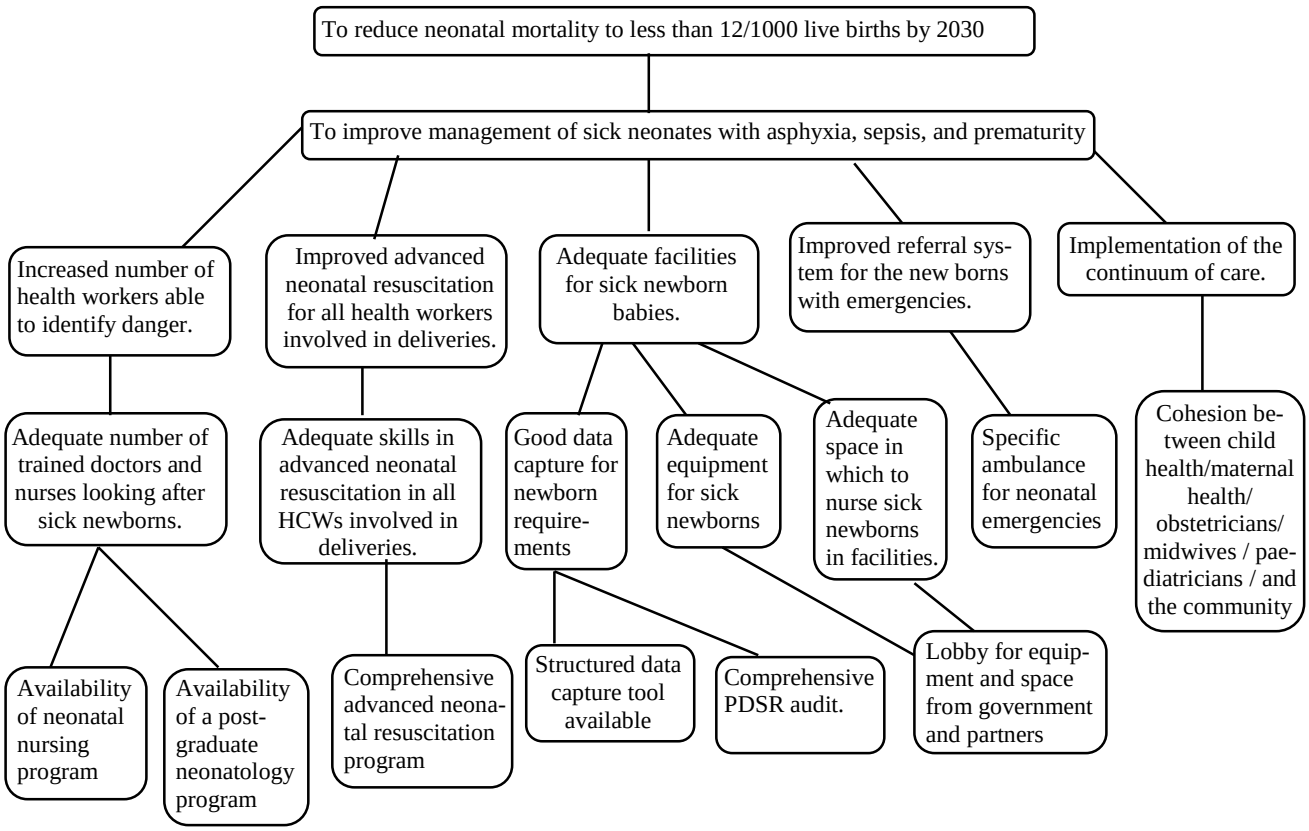
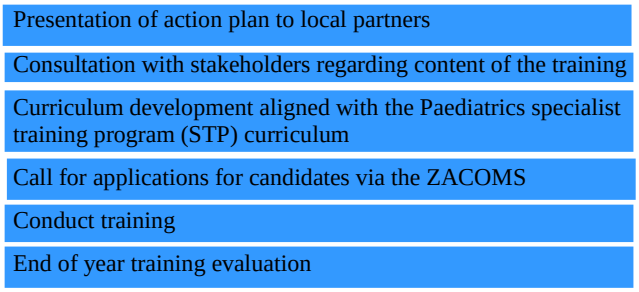


Fig 3: Activity flow plan



Student Feedback
Student evaluations

1. Individually completed anonymous survey of all candidates who completed the postgraduate diploma in neonatology.

Table 5: Individual Survey Monkey Questions

	Question	Strongly agreed	Agree	Neutral	Disagree	Strongly dis-agree
The objectives of this training were clearly defined	Cohort 1-2020	55.56	44.44	00.0	00.0	00.0
	Cohort 2-2021	33.3	50.00	16.67	00.0	00.0
Participation and interaction were encouraged	Cohort 1-2020	77.78	22.22	00.0	00.0	00.0
	Cohort 2-2021	66.67	16.67	16.67	00.0	00.0
The content was organized and easy to follow	Cohort 1-2020	33.33	33.33	33.33	00.0	00.0
	Cohort 2-2021	16.7	16.7	50.0	16.7	00.0
The topics covered were relevant	Cohort 1-2020	66.67	33.33	00.0	00.0	00.0
	Cohort 2-2021	83.33	16.67	00.0	00.0	00.0
This training experience will be useful in my work	Cohort 1-2020	88.87	11.11	00.0	00.0	00.0
	Cohort 2-2021	83.33	16.67	00.0	00.0	00.0
The trainers were knowledgeable about the training topics	Cohort 1-2020	77.78	22.22	00.0	00.0	00.0
	Cohort 2-2021	100	00.0	00.0	00.0	00.0
The trainers were accommodating and helpful	Cohort 1-2020	66.67	33.33	00.0	00.0	00.0
	Cohort 2-2021	83.33	00.0	16.67	00.0	00.0
Different guest trainers were useful	Cohort 1-2020	22.22	66.67	11.11	00.0	00.0
	Cohort 2-2021	33.00	50.00	00.0	16,67	00.0
The trainers were available for consultation and teaching	Cohort 1-2020	44.44	55.55	00.0	00.0	00.0
	Cohort 2-2021	66.67	16.67	16.67	00.0	00.0
The training objectives were met	Cohort 1-2020	11.11	66.67	22.22	00.0	00.0
	Cohort 2-2021	00.0	66.67	33.3	00.0	00.0
The training was evidence based	Cohort 1-2020	33.33	33.33	33.33	00.0	00.00
	Cohort 2-2021	42.86	57.14	00.0	00.0	00.0
The call rooms were comfortable	Cohort 1-2020	00.0	22.22	44.44	22.22	11.11
	Cohort 2-2021	28.57	42.86	28.57	00.00	00.00
The call/study rooms were sufficient	Cohort 1-2020	00.00	33.33	11.11	44.44	11.11
	Cohort 2-2021	28.57	57.14	00.0	14.29	00.00
Learning via Zoom provided a good alternative	Cohort 1-2020	11.11	22.22	33.33	11.11	22.22
	Cohort 2-2021	42.86	14.29	14.29	14.29	14.29
Face to face learning was adequate	Cohort 1-2020	00.00	33.33	22.22	44.44	00.0
	Cohort 2-2021	00.0	57.14	14.29	28.57	00.0
The equipment at the training site was sufficient for training	Cohort 1-2020	00.0	33.33	33.33	33.33	00.0
	Cohort 2-2021	00.0	28.57	14.29	42.86	14.29
The Neonatal Unit had enough patients to facilitate learning	Cohort 1-2020	66.67	33.33	00.0	00.0	00.0
	Cohort 2-2021	57.14	42.86	00.0	00.0	00.0
The continuous assessment given was adequate	Cohort 1-2020	12.5	75.00	00.00	12.50	00.00
	Cohort 2-2021	14.29	42.86	28.57	14.29	00.0
The time allocated for the training by ZACOMS was sufficient	Cohort 1-2020	00.0	22.22	55.56	11.11	11.11
	Cohort 2-2021	00.0	14.29	28.57	57.14	00.0
There was enough time to study	Cohort 1-2020	00.00	22.22	33.33	44.44	00.0
	Cohort 2-2021		28.57	42.86	14.29	14.29
Mentorships conducted in the district facilities were relevant to the training programme	Cohort 1	87.50	12.50	00.0	00.0	00.0
Mentorships conducted in the district facilities were relevant to the training programme	Cohort 1	00.0	75.00	25.00	00.0	00.0
Combined revision sessions with the STP paediatrics students were useful	Cohort 1	12.50	50.00	25.00	12.50	00.0
Involvement in the Community Newborn Care Training was useful	Cohort 1	87.50	12.50	00.0	00.0	00.0
The facilities were enough to help me learn the concepts	Cohort 1	00.0	33.33	55.56	11.11	00.0

The total number of 14/16 students participated in the anonymous survey, with a 90% completion rate on a 20-25question survey. These included both cohorts of students.

The general agreement in both the first and second cohort (91%) that the objectives of the training were clearly defined, and participation and interaction were encouraged (92%). Over 65% of the respondents agreed that the objectives of the training were met.
Generally, most of the students felt that the topics covered were relevant as the focus was centred around commonly seen cases during the second year of training.
Although the training was conducted in an environment that was not ideal with insufficient equipment for training and inadequate call room space (which was improved in the second year), almost all the students agreed that the training would be useful in their work. The practical concepts of caring for a small and sick newborns had been learned by 80% of the trainees.
The programme used different guest trainers and over 80% of the respondents agreed that the guest lecturers were useful for the training. Both guest and local trainers were available for consultation and teaching 89% of the time. However, the trainees felt that more presence of the consultant would have been valuable in the Outpatient follow-up clinics. Availability of the one of the two consultants was based on workload on the busy neonatal unit.

Both face to face and virtual training were used. This blended learning mainly accommodated doctors whose shifts were affected by COVID restrictions. Most students preferred in-person learning.
Training was based on current literature and best practices albert the limited facilities, 65% of the respondents felt that the training was evidence-based.
Though agreed that the neonatal unit had enough patients to facilitate learning, the students felt that they were carrying a heavy patient load and had inadequate time to study. This made them feel that the time allocated for training by ZACOMS was short.

The mentorship and community newborn outreach were mostly conducted during the first year of the programme but the second year was disrupted by the COVID 19 pandemic. The majority (87%) of the candidates felt that this was a relevant part of the training as it exposed them to facilities outside the training institution. They were involved in the situation assessment and setting up KMC units in district facilities referring neonates to Women and Newborn Hospital, units created as step down facilities to help decongest WNH.

During the study break prior to exams, the candidates were encouraged to join the revision sessions presented by the Paediatric registrars. They were able to appreciate the depth of knowledge required at Master's level such as the Master of Medicine (MMed) in Paediatrics and Child Health and this motivated some of them to join the MMed Paediatrics and Child Health Programme.

Focus group discussions

Two independent reviewers conducted focus group discussions with the first two cohorts of students.

Focus group discussion conducted with a subset first cohort of diploma candidates

In December 2020, five of the nine randomly selected trainees participated in a focus group discussion moderated by an independent Consultant Paediatrician (MMed, MTropPaed) who was not involved in the training. Specific topics discussed during the FGD included course duration, delivery, content, and structure. The report was presented with these themes and the evaluator drew conclusions from the discussion. Despite the teething problems, the candidates felt the course would improve care of the sick neonates. Much of the major concerns including the uncertainty regarding future progression after completion of the course.

Independent evaluation by faculty of the MMed Paediatrics and child health

This was an independent evaluation by faculty of the MMed Paediatrics and Child health of two diploma candidates who proceeded to enroll in the Paediatric MMED program after completion of the PGDip in neonatology. Each student was independently assessed in their competence and confidence by a Supervisor from the MMED program.Supervisor assessment found that in comparison to their peers, the graduated diploma students were passionate about providing neonatal care both in the hospital and in the community and were demonstrably confident in their identification of common neonatal conditions, ability to manage critically ill neonates, and conduct of required procedures without supervision. The students were able to make decisions promptly to improve outcomes and had a good sense for when to consult with seniors. However, limitations were noted in their ability to give a detailed understanding of the pathophysiology of neonatal illnesses and the rationale for their subsequent management, showing a heavy reliance on the neonatal protocols. Detailed and objective history taking skills and presentation of general paediatric patients during teaching rounds was also below the expected standard.

Course evaluation for the second cohort –virtual focus group discussion

In December 2021, an independent reviewer from Cape Town University conducted a virtual focus group discussion. All the seven candidates participated.
His conclusion from the FGD was that this programme seemed like a very worthwhile course that improved both the participants and the quality of health care delivered. All students were extremely complimentary about the trainers/'bosses. As with all courses, especially new ones there will be teething problems and aspects that need improvement.

Reflections on the execution of the first and second cycle of the postgraduate diploma in neonatology

The first cohort of the PGDip in Neonatology students achieved its goals of recruiting and training medical doctors to provide a markedly improved standard of care to small and sick neonates. At six months' post-graduation, the programme boasts 90% successful recruitment, 100% graduation of candidates, and 100% retention of graduates in clinical roles related to neonatology and/or child health.

During the training period, the candidates increased staffing levels on the ward, enabling the neonatology unit at the referral hospital to field an adequate complement of doctors. Mortality audits were done for each patient.

The second cohort also had an initial recruitment of 9 candidates but 7/9 (78%) graduated. Both students who left intended to complete the training. The training for the second cohort was relatively easier to execute as five of the fellows from the first cohort were now involved in the unit activities. The second cohort were sometimes taught together with the new cohort of NNPs training cohort as the content is the similar. The NNPs benefitted a lot from the shared postgraduate training (both knowledge and skills).

Strengths of the programme

The introduction of this cadre saw increased advocacy for neonates in the Zambian health system evident in the candidates' willing participation in MPDSR meetings, World Prematurity Day celebrations and community engagement activities. The passion and goodwill of both the students and faculty, facilitated the programme's success despite the resource limitations.

Challenges faced during the training period

Nine candidates instead of the desired ten applied in the first year (2020). This was still satisfactory as the course was still new and needed to gain the confidence of prospective candidates. We anticipate that the endorsement of the graduated class, improvements in course infrastructure, and clarity on career progression will contribute to the course's appeal in Zambia and the region.

The career progression of the candidates enrolling in the course was unclear at the outset. However, some of the candidates have enrolled into the MMed Paediatrics programme with stronger skills in the care of neonates. The course is suitable for career Medical Officers who may wish to spend the rest of their careers caring for neonates.

There was also inadequate funding for payment of faculty for the added responsibility and teaching and mentorship was delivered *pro bono*.

Changes to the programme and future directions

Based on recommendations from the inaugural class and course faculty, changes have been made for the new cohort, including renovation of the night call room, and procurement of a desktop computer, laptop computer and overhead projector for the training programme. In response to the concerns raised about the academic component, a larger number of outside lecturers have been engaged to provide meaningful input, and candidates will be joining the first-year registrars of the MMed/ Specialist Training Programme Paediatrics and Child Health students for academic sessions on common topics. Plans are also in place to extend and realign the sessional calendar dates to enable candidates to complete the training over one year, and smoothly transition to other academic programmes if desired.

While the diploma addresses the immediate need for interventional skills to improve birth outcomes, the need for trained and certified neonatologists remains, and it is hoped that interest and support will continue to grow in order to support continued and advanced (e.g. fellowship) level training in neonatology. The University of Zambia now has a curriculum for Masters of Science in Specialised Medicine-Neonatology but requires more faculty to train a well-rounded neonatologist.

Funding support remains critical to optimizing delivery. Internet access, availability of better and functional equipment and investigative capacity would be ideal.

Introduction of a neonatal nursing programme

Neonatal nurses are the backbone of neonatal units and have had even fewer training resources available. Following on from the success of the postgraduate diploma in neonatology, and in collaboration with the University of Zambia (UNZA) School of Nursing Sciences, the first cohort of eight candidates is currently enrolled in a 2-year Master of Neonatal Nursing programme in 2021. Council of International Neonatal Nurses (COINN) have been engaged to help strengthen the training with goodwill from the Zambian Ministry of Health Permanent Secretary.

We have also set up a One-year programme to train bedside advanced neonatal nurses whose lecturers are the NNP programme students. This training is under the Nursing and Midwifery Council of Zambia (NMCZ)

Fig 4: Training cascade-neonatal care work force

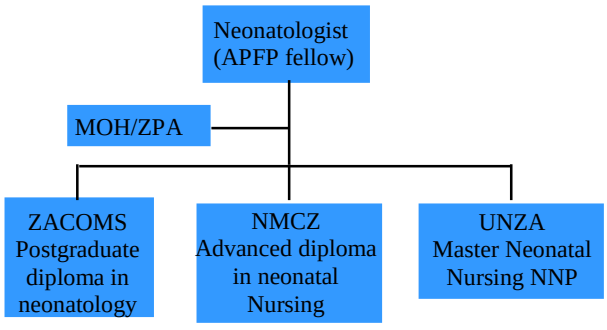
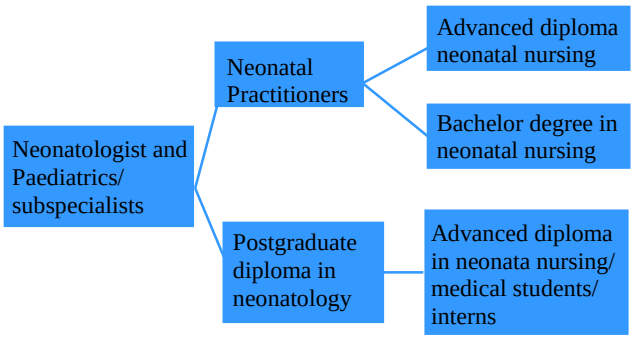


Fig 5: Parallel transfer of skills and knowledge



Conclusion

The design and implementation of the postgraduate diploma in neonatology for Medical Officers with additional programmes for their nursing colleagues is a key step in establishing a skilled workforce to facilitate achievement of the Sustainable Development Goal (SDG) 3.2 of reducing neonatal mortality to <12/1000 live births by 2030. [14]

The in-depth evaluation of the postgraduate diploma in neonatology, delivered in a Zambian tertiary centre, demonstrates that it is feasible to deliver skilled-focussed training in low-resource settings, and improve quality of care and possibly neonatal outcomes. The training produced a group of competent and confident clinicians, ready to serve as champions of specialist training in neonatology and as advocates for neonates. This cadre will be useful in creating a critical mass of specialists committed to addressing the gaps in management of sick and small newborns. In-depth evaluation of the other training programmes is pending. According to the weekly neonatal mortality reports, the past two years have seen a reduction of the WNH neonatal unit mortality by about 40%.

We will continue working with the partners and the Zambian Ministry of Health to refine and strengthen these programmes. Our view is that it is important to implement these programmes while trying to access resources than not starting at all.

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