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Research

Towards a safer and more efficient neonatal transfer system in South Africa: A qualitative inquiry with ALS paramedics

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Abstract

Introduction
The inter-healthcare transfer of the critically ill neonate is a critical aspect of larger neonatal intensive care, as it influences the safe transport of neonates from the receiving to the referring hospital. It is crucial then that the transfer process be safe and efficient so as not to compromise the already fragile condition of the neonate. The aim of the study was to understand the challenges advanced life support (ALS) paramedics face during neonatal transfers and to understand how the process could be made safer and more efficient. The objectives related to understanding the transfer process, the challenges linked to the critically ill neonate and the difficulties associated with the ambulance vehicle and equipment.

Methods
Using a qualitative research approach we sought the views of ALS paramedics at the forefront of transfers nationally. In-depth interviews were held with eight paramedics in KwaZulu-Natal and four focus group discussions with ALS paramedics in KwaZulu-Natal, Gauteng, Free State and the Western Cape in South Africa. A total of 35 ALS paramedics were involved in these group discussions.

Results
The study uncovered several challenges that paramedics face related to poor organisational preparation for transfer of the critically ill neonate, and other crucial issues that compromise the transfer such as inadequate or defective equipment.

Conclusion
There is a need for greater scrutiny of the transfer process and a commitment from stakeholders to begin addressing the challenges confronting the safe transfer of critically ill neonates.

Keywords:
neonatal; transfers; advanced life support paramedics

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Introduction

The inter-healthcare transfer of the critically ill neonate is a critical aspect of larger neonatal intensive care, as it influences the safe transport of neonates from the receiving to the referring hospital. It is crucial then that the transfer process be safe and efficient so as not to compromise the already fragile condition of the neonate. The aim of this study was to understand the challenges advanced life support (ALS) paramedics face during neonatal transfers and to understand how the process could be made safer and more efficient for the neonate patient.

Methods

Study design and setting

A qualitative, explorative and descriptive design was used to seek the views of ALS paramedics involved in the transfer of critically ill neonates. The theoretical underpinnings of exploratory, descriptive research have been supported by Hunter et al (1). They argued that it has a place in health research and can be deemed the most appropriate methodology to achieve the objectives related to healthcare research. ALS paramedics were selected to participate in this study from four major provinces in South Africa: Free State, Gauteng, KwaZulu-Natal and Western Cape Province and included paramedics involved in urban and rural, public and private, ground and air ambulance transfers. The study was conducted between 2016 and 2017. The research team involved one primary researcher (PA, now deceased) and a co-investigator (RB).

Population and sampling

The population for this study included ALS paramedics nationally. However, when using qualitative research approaches, smaller more purposive and convenience samples are appropriate to derive the information richness required (2). Non-probability sampling methods then more specifically purposive sampling was used to select only those paramedics who had been specifically involved with neonatal transfers. Two samples were used, although both included ALS paramedics. The first sample was drawn from KwaZulu-Natal only and included eight participants in in-depth interviews. The second sample was drawn from the abovementioned four provinces in South Africa and included 35 participants. In total, four focus group discussions were held. Nine participants from KwaZulu-Natal, six participants from Gauteng, 11 participants from Free State and nine participants from Western Cape agreed to participate in the study.

An invitation to participate in the study was made through the respective heads of emergency medical services (EMS). Sample 1 – ALS paramedics involved in transfers undertaken in December 2015 were contacted by the researcher and invited to participate. Those who agreed to participate were contacted and arrangements made to meet at department of health premises for purposes of convenience. Sample 2 – the researcher forwarded a detailed letter via email or post, or through the heads of EMS, inviting ALS paramedics who were directly involved in neonatal transfers to participate in a focus group discussion. Those who volunteered were informed of the date for the data collection and advised of the venue.

The inclusion criteria for Sample 1 and Sample 2 were as follows: ALS paramedics who worked in urban/rural, public/private and grounded/aeromedical ambulance sectors. This was to ensure representation from all sectors. ALS paramedics who were involved in the transfer of critically ill neonates were recruited. These paramedics either qualified as critical care assistants or emergency medical care practitioners.

Ethical considerations

Ethical clearance was obtained from the Durban University of Technology Institutional Research Ethics Committee (093/15). Permission was thereafter obtained from all provincial departments of health via the National Health Research Database and the private sector EMS head office. All participants were informed (via letter and verbally) before data collection that their participation was voluntary and that they could withdraw at any time. They were assured of anonymity and that their identifying details were confidential, and informed that there were no financial benefits through participation but that the findings would be disseminated through publications.

Data collection

Data was collected from Sample 1 using in-depth semi-structured interviews that enabled the researcher to collect rich data from the ALS paramedics regarding the challenges experienced during the transfer process. Sample 2 focus group discussions (considered more convenient) were used to understand not only their challenges but to enquire what was needed to achieve a safer and more efficient transfer of the neonate. An interview guide and a focus group schedule were used to collect data from Samples 1 and 2. Both tools were pilot tested with similar samples before use and refined accordingly. The data was recorded using an audiotape and field notes were taken.

Data analysis

The data for both samples was undertaken using thematic analyse as per the steps outlined by Braun et al (3). Thematic analysis allowed the researcher to make sense of the collective meanings and experiences of all participants and enabled the data to be organised and reduced into relevant themes and sub-themes. A preliminary coding scheme was generated, which served as a template for the data analysis (4). Similar themes and recurring patterns in the data were linked together and the contrasts and differences identified (5).

To enhance the trustworthiness of this study, the researchers made use of Guba's model (6). The four criteria to ensure rigour in qualitative studies – credibility, dependability, conformability and transferability – were adopted. Strategies included member checking, the triangulation process as evidenced by the collection of data using interviews and focus groups, maintaining

an audit trail and keeping a reflective journal (7). This ensured trustworthiness of data and reflexivity of the researcher. Finally, an expert evaluation committee was used to validate the findings.

Results and discussion

Theme 1: Re-structuring the neonatal transfer system
All participants agreed that there was an urgent need to restructure and develop the transfer system for critically ill neonates. The inter-healthcare facility transfer of neonates requires a sound organisational system with essential structural components. Regardless of the high level of knowledge and expertise, organisational structures are a crucial component of maintaining or improving neonatal care (8,9). Resource limitations include a lack of essential equipment, trained professionals, structural restrictions and appropriate systems to manage patients. Within most African emergency care settings, resource limitations involving one or more of these factors are common and impact the success of a safe transfer. The following sub-themes emerged related to restructuring.

Sub-theme 1: An integrated and standardised approach
Participants indicated that there was a lack of an integrated approach between the hospitals and the emergency medical service, as transfer teams worked independently from hospitals. They also indicated differences in the way neonatal transfers were undertaken across different provinces and within each province, calling for a unified and systematic approach to guiding how neonatal transfers are performed across the country.

> "We are working in silos, the hospital got their own system going and we have ours… so at this stage it is about them and us, not the baby." [ALS, focus group]

> "There are differences in the way things are done between provinces and the way things are done within provinces. There has to be a standardised system in South Africa." [ALS, focus group]

Kage et al (10) argued that neonatal transfer systems in developed countries were successful because of the consolidation of various elements of the transfer service into one unified and standardised program. The decision to transfer a critically ill neonate is a complex one, due to the multiple stresses associated with the transfer (9,11). This demands a systematic, integrated and standardised approach among the referring hospital, the transportation team and the receiving hospital. This is in stark contrast to the fragmented approach being suggested by one of the participants.

Sub-theme 2: Dedicated neonatal units and specialised teams
Participants expressed that one approach to addressing time delays, equipment issues, safety challenges and providing optimal care was having a dedicated specialised unit and team for neonatal transfers. Neonatal transfer services in well-resourced countries have evolved significantly over the past 25 years (8). Moreover, it has been documented that these specialised units and teams have been found to prevent many life-threatening adverse events during transfers and have served to reduce crucial time delays during transfers (12-17).

> "One of the biggest problems we have in critical neonatal transfers is that we don't have a dedicated specialised unit for these transfers. That is one of the main reasons for the transfer delay, because when we get a transfer, we have to now go around looking for equipment, looking for crews, looking for an ambulance." [ALS, focus group]

Participants also suggested that the transfer team should be used solely for neonatal transfers and that the team should include at least two team members (excluding the driver or pilot). As ALS providers are the pre-hospital care specialists in South Africa, they are primarily responsible for undertaking inter-healthcare facility transfers of critically ill neonates. This should include the team leader and an assistant with appropriate qualifications and expertise. They added that the minimum qualification of the team leader should be an ALS paramedic who is qualified to undertake neonatal transfers. They argued that when new guidelines are approved the minimum qualification of the team leader should be a Bachelor of Technology in Emergency Medical Care or bachelor's degree in emergency medical care. A more rigorous four-year academic qualification would then strengthen the ability to cope with the complexities of neonatal transfers. With regards to assistants, they suggested it should preferably be an emergency care technician or, at a minimum, ambulance emergency assistant.

> "The senior should be an ALS paramedic who is qualified for critically ill neonatal transfers, currently it is the emergency care practitioners, national diplomas, critical care assistants but when and if the new proposed guidelines are approved then ECPs only. For the assistant, an emergency care technician is ideal but if not then a minimum of an ambulance emergency assistant would do." [ALS, focus group]

Karlsen et al (18) explored the composition of neonatal transport teams in the United States and found that successful transportation of a neonate was best accomplished by a team of two or three healthcare professionals. In addition to the competency of all team members in neonatal intensive care, a delegated team leader who manages the entire transfer and can manage any potential crises is important (14).

While each country needs to adapt practice to their unique contextual realities, what is clear is that a separate unit, dedicated solely to transfers, with specialised teams has huge advantages. The literature reflects that in developed countries, specialised retrieval teams of physicians, anaesthetists, respiratory therapists, paramedics, neonatal intensive care

nurses or a combination of experts from these disciplines from individual healthcare facilities form the backdrop to successful neonatal transfer (8,19). There was no evidence however to indicate that any specific professional contributed to improved outcomes on a transfer. Woodward et al (20) argued that a successful transfer team requires good leadership and all team members should be able to demonstrate flexibility, critical thinking, independence, timely judgement, problem solving skills, interpersonal and communication skills and appropriate crisis resource management.

Transfers of neonates in other developed countries are structured and use well-developed regionalised programs, with a cadre of appropriately skilled human resources (14). They operate under advanced medical directives with access to telephone clinical advice, preferably from senior physicians with specific neonatal and transport expertise. Jackson et al (21) indicated that a skilled and experienced transfer team functions as an extension of the downstream healthcare facility to bring expertise to the bedside of the referring facility. There is considerable diversity in those who undertake the neonatal transfer, including combinations of physicians, paediatricians, neonatologists, respiratory therapists, anaesthetists, nurses and paramedics (22-24).

Specialised neonatal transfer teams show improved overall transit time (8,19,21,25). Specialised dedicated transfer teams and units for critically ill neonates however do not exist in many developing countries with the transfer done by staff with little experience and insufficient equipment, thus increasing the risk of complications during the transfer (8). This lends support to findings that emergency care physicians (ECPs) become team leaders in the neonatal transfer process.

Sub-theme 3: State-of-the-art equipment

Issues related to equipment that was malfunctioning, incompatible or issues of poor infection control emerged in the data. A bigger challenge was that appropriate equipment was not even available.

> "Sometimes we have to transfer the babies who are very unstable, sometimes we have long transfers. The equipment always fails. Batteries don't hold charge. Our equipment is old and outdated." [ALS, interview]

> "Most of our incubators do not work properly. They don't retain heat… Sometimes we put a hot water bottle inside, I don't know if that's allowed but we try and keep the heat… It's not only the incubator, our ventilator does not work properly as well. Often the battery just dies, modes go off and we cannot do the settings according to the hospitals…" [ALS, interview]

> "We don't have proper monitoring equipment to monitor vital signs and end-tidal CO_2. We're just using a portable pro-pack monitor that gives you stats monitoring, it gives you BP monitoring, there's no end-tidal CO_2, it cannot defibrillate. That's one of the challenges and we've got others. Our syringe pumps are not serviced and they don't buy the proper administration sets for it, so we have to basically make a plan, we jam the sensor section with syringe just to make sure the thing doesn't beep all the time." [ALS, interview]

> "There were instances where we had to do back-to-back transfers on the same ventilator, a 4-hour mission with a baby on a ventilator. This will obviously bring the ventilator battery life down to about a quarter and then you're asked to bring another ventilated baby back with quarter battery life. It started to give us a low battery and low pressure warning so I revert back to bag valve mask and bag the baby." [ALS, interview]

> "We don't have proper sterilising equipment to clean the incubators. All our incubators don't have any proper disinfectant to disinfect the incubators, we use hibitane, which is not a proper disinfectant, its alcohol based. The incubator takes filters, it has not been changed for years." [ALS, interview]

As critically ill neonates require intensive care, equipment must be functional to meet the needs of any clinical emergencies that arise during transfer. As evidenced in the data, transfers often involved unstable neonates who must be transferred for long periods within a context of malfunctioning equipment as well as incubators that do not work. The use of a hot water bottle to generate heat presents the stark realities of what unfolds within the transfer journey. The lack of proper monitoring equipment, the pressure of back-to-back transfers where the ventilator battery life ran low during an air transfer adds to the pressure and helplessness that paramedics face in trying to keep the neonate alive. Moreover, the fact that equipment is not properly serviced and that there is a lack of sterilisation of the requisite equipment adds to the grim realities faced within transfers and must be considered to prevent neonatal mortality.

In Japan, Hiroma et al (26) emphasised the importance of specialised equipment for a neonatal transfer. This should include incubators, respiration and heart rate monitors, SpO_2 monitors, infusion pumps, aspirators, air and oxygen blenders, artificial respirators and seatbelts. All perinatal centres who participated in their study indicated that the lack of specialised equipment made the transfer difficult in terms of monitoring vital signs, supporting ventilation and avoiding hypothermia. Findings from this study cohere with those in other studies regarding equipment related issues (14,15).

Carreras-Gonzalez and Brió-Sanagustin (12) added that in aeromedical transfers equipment should be certified, specific to the aircraft, and any change to the equipment should necessitate recertification. Equipment-related faults, no matter how minor, should be referred immediately to the designated technologist

for investigation or repair with a prompt return. This is relevant in light of the findings made in relation to air transfers in the current study. Singh et al (27) argued that although an incubator is designed to provide warmth, stillness, humidity and security for the neonate, it should be mandatory that the baby is secured in the incubator while still allowing easy access to intravenous lines and the airway. Ambient noise and vibration are concerns in both land and air transport (28,29). Gajendragragadkar et al (30) suggested that an air-foam mattress and gel pillow be used to reduce potentially harmful vibrations that may lead to morbidity.

Finally, given the difficulties experienced with poor battery life in ventilators, it is crucial that a fixed backup power source (and a portable power source) be available for transition to and from the ambulance. Power supply extensions should also be available as external supplies when necessary and oxygen and medical gas requirements should be determined and estimated before commencing the transfer. Equipment should also be lightweight, compact, durable, well secured for safety reasons and motion and g-force tolerant (30).

Theme 2: Improved organisational structures
The need to improve the current organisational structure in relation to neonatal transfers by having specialised managers and appropriate documentation was evidenced under the following sub-themes.

Sub-theme 1: Specialised managers
Participants lamented the lack of adequate support within the transfer system, saying that while resources were available, a good manager could coordinate and facilitate the transfer process while providing support. In addition, they argued for a manager who had the requisite knowledge to support the ALS paramedic who was making the transfer. In developed countries, specialised managers form the core of the transfer system and include physicians and doctors within their management structures (31). Although South Africa and other developing countries do not have such specialist managers, an appropriate management structure should include: a medical officer with specialty training in neonatology or equivalent expertise to oversee appropriate departments and ensure quality assurance; a manager for neonatal transfers with an ECP qualification and experience in neonatal transfers to oversee its day-to-day management and quality assurance; and a transfer coordinator with an ECP qualification and experience in neonatal transfers who is responsible for the clinical supervision, screening and coordination of the entire transport process while in progress.

> "Support structure at the moment is non-existent, management does not give us any support. We need a good management structure, there are enough human resources but they are not used appropriately." [ALS, focus group]

> "The communication centre must have an ALS coordinator who is current with evidence-based medicine. This would be appropriate because an ALS understands the transfer process involved with critically ill neonates." [ALS, focus group]

Sub-theme 2: Neonatal documentation
Participants argued that detailed information was crucial to guiding those undertaking the transfer saying that due to the stress of the pre-hospital environment and that encountered during the transfer, assessment checklists were vital to guiding clinical care during the transfer. The transfer request form in the emergency management communication centre must include as much detail of the transfer as possible, beginning with the neonate's details (name, age and weight, gestational age, gender, diagnosis, history and vital signs); then details regarding the neonate, including normal value parameter, blood gasses and formula. These should be attached to the cover of the report form for easy reference during transfers. Craig et al (32) argued the need for a specialised neonatal transfer form to reflect information from the time the transfer was dispatched to the transfer team to the time of completion of the transfer. This information should include timeframes, neonatal details, history, evaluation and treatment (all entries should be timed), medication given (dosage and time) vital signs (ongoing basis), blood gasses and bio-chemical values, the neonate's condition pre, during and post transfer, any changes in the neonate's condition, adverse events, take over and hand over personnel, and proof of documents from the referring and receiving facilities. Appropriate documents should also capture communication, decision making, clinical management and other salient issues related to the transfer process in its entirety (20). The latter is crucial to providing a contextual understanding of the transfer once the neonates arrives at the receiving hospital for ongoing care.

> "We found very valuable the cover of our patient care books, have the neonate's normal values, blood gases values and formulas if you need them they are there." [ALS, focus group]

> "Assessment checklist will be ideal. In the pre-hospital environment there is a lot of stress, these babies are not easy to deal with, then the noise, the adrenaline rush, the excitement. You can miss important treatment or procedures; there the assessment rubric will ensure that all steps are covered." [ALS, focus group]

Theme 3: Transfer dynamics
Information regarding the neonate before the transfer, preparing the ill neonate, monitoring the transfer request form in the emergency management communication centre must include as many details of the transfer as possible, including the neonate's details (name, age and weight, gestational age, gender, diagnosis, history and vital signs).

Sub-theme 1: Salient information regarding the neonate
In addition to having important documentation, participants

argued the need for important information regarding both the transfer and clinical condition and procedures undertaken to be conveyed to the paramedic involved in the transfer. What emerged was that details of the referring and receiving hospitals, relevant departments and the names and contact numbers of referring and receiving personnel were important. More importantly, participants argued for a transfer coordinator who should screen and coordinate the overall transfer process.

> "I think during the activation phase it is critical that the dispatcher give us the correct information about the child and the necessary equipment required because we need to prepare for the transfer." [ALS, focus group]

> "I don't know if this is an oversight or if it is omitted on purpose, when the baby has been resuscitated we are never told about that. We need to know what treatment was done on the baby, so we are prepared for any deterioration en-route to hospital." [ALS, focus group]

> "It will be good to call the receiving hospital and tell them that we are coming through because often they don't have neonatal ventilators; they only intubate the baby when we get there and it takes time... So by them knowing we are coming they must prepare the neonate." [ALS, focus group]

Horowitz et al (33) stated that when a call is received the referring doctor/nurse should record all necessary information. This information should include the neonate's name, age and weight, gestational age, gender, diagnosis, vital signs equipment required, medication, infusions, arterial blood gases, ventilator settings, urgency of transfer, treatment and special conditions. As participants said, this vital information is important to guiding clinical care and intervention during the transfer and such information is crucial to those medical personnel receiving the neonate.

The preparation phase should be guided by the transfer team before proceeding to the referring facility. In South Africa, it is suggested that the most senior medically qualified person on the team be automatically designated to be the team leader and should be responsible for the team and the transfer operations. Although the team leader is ultimately responsible for the transfer, all team members should work collaboratively and understand their respective responsibilities. Ashokcoomar et al (34) and Mgcini (35) reported that preparation for the transfer of ill neonates in South Africa has been poorly executed. They suggested that once the dispatch is received by the team leader, all details regarding the neonate should become clear. Where there are ambiguities the team leader should seek immediate clarity. Most importantly, the team leader should be familiarised with the neonate's condition, treatment already undertaken, equipment required and any other information vital for the transfer.

Participants reported that failure to inform transfer staff of resuscitation efforts before a transfer leaves them ill-prepared to anticipate clinical deterioration during the transfer. As evidenced in the data, the receiving hospital also needs to be briefed regarding the arrival of the neonate, as they are often ill-prepared to receive the neonate. The team leader should therefore carry out a transfer pre-briefing to inform team members of the neonate's condition, equipment required and other transfer issues. A pre-departure checklist should also be completed to ensure that all necessary equipment is available.

Sub-theme 2: Preparing the ill neonate

Participants recommended that the retrieval process begins with a comprehensive handover by the referring doctor that includes history-taking. They argued that part of preparing the neonate is the opportunity to read the medical notes and review charts, obtain the latest arterial blood gas, collect all necessary documentation and ensure that the baby has name tags. Gunz et al (36) described the retrieval phase as being the most important of the transfer process. According to Grosek (37), a range of things can go wrong during the transfer with a minor physiological change in the condition of the neonate that can cascade into a life-threatening complication. He added that while it is possible to undertake invasive procedures during the actual transfer it is not ideal, and the neonate should be stabilised and properly packaged (with attention to pre-transport stabilisation) to minimise clinical instability and complications that might arise during the transfer in order to ensure a good neonatal outcome.

> "The baby must be well prepared… everything must be done at the hospital first before leaving." [ALS, focus group]

> "We need the transferring doctor because he is the one that treated the baby and this is an intensive care patient, we need a formal handover, we need all information, what was done, what was given, a full history so if anything is going wrong en-route we have an understanding of why and what is happening." [ALS, focus group]

> "Do a head to toe examination, follow an ABCDE approach, check the airway, check breathing, check the circulation, and check the circulation, the drips, the medication, is the incubator warm." [ALS, focus group]

> "All monitoring equipment must be on the baby, the baby must be comfortable on the portable ventilator, incubator must be warm to the right temperature, all the infusions must be running, try to have two sats monitor if you can." [ALS, focus group]

Emergency care clinical guidelines developed for national uptake in the pre-hospital sector in South Africa are important to consider within the context of neonatal transfers (38). Droogh et al (15) suggested that the neonate should be assessed for respiratory efforts and inspired oxygen may be guided by SpO_2

(estimate of arterial oxygen saturation) and $EtCO_2$ (end-tidal carbon dioxide). Intubated neonates should normally be sedated and ventilated before transferring them onto the transport stretcher and monitoring equipment attached. Karlsen et al (18) wrote that the neonate may take a while to stabilise on the portable transport ventilator, after which, if possible, an arterial blood gas should be performed before departure. A bag-valve-mask should always be readily available and if a pneumothorax is present, a chest drain should be inserted before departure.

As participants in the study argued, the neonate needs to be comfortable on the ventilator. Once stabilised, at least one arterial blood gases should be performed before departure to ensure that the neonate is ventilated appropriately. Hypothermia, hypoglycaemia and metabolic acidosis are reversible courses and have a significant negative impact on the transfer and the eventual patient outcome. Therefore, it should be corrected before the transfer.

Karlsen et al (18) asserted that venous access is mandatory, with all intravenous lines needing to be secured and redundant intravenous lines and infusion not vital to the neonate's treatment removed, the line flushed and capped. All infusions should be running, and should there be doubt about the infusion, the doctor should be consulted and a new infusion drawn up. Nasogastric/orogastric tube, urine catheter or any other drains necessary for the transfer should also be secured in place and free drainage allowed into collection bags, which should be emptied before the transfer. McEvoy et al (14) indicated that adequate sedation and/or analgesia should be provided and if inotropes or other vasoactive agents are required to optimise haemodynamic status, the neonate should be stabilised before leaving the referral unit. Moreover, the administration of all medication should be documented to avoid inadvertent repeat dosing and toxicity.

Singh et al (27) stated that the neonate needs to be well secured and protected from the environment before departure, and maintaining a thermal neutral environment for the neonate during transportation was essential to avoiding thermal stress, which may create a metabolic effect (28). The transport incubator should be set at the appropriate temperature and the neonate secured in the incubator to protect them from sudden acceleration or deceleration of the vehicle or the g-force or turbulence of the aircraft.

Sub-theme 4: Close monitoring during a transfer

The need for close monitoring during the transfer itself also emerged in the data. Participants said:

> "Put all monitoring on the patient, don't rely on just one form of monitoring, attach everything, because with the noise, vibration, lighting and so on, it's easy to get a false reading, so attach everything." [ALS, focus group]

> "Often we all strap the incubator to the stretcher, but what about the baby in the incubator, if the baby is not strapped in the incubator, the baby can be a projectile in the incubator which can cause serious injuries to the baby." [ALS, focus group]

As evidenced in the excerpts, multiple issues may arise during the transfer related to the monitoring equipment and if the incubator is not secured firmly during the transfer. Monitoring equipment includes an electrocardiogram (ECG), non-invasive blood pressure (NIBP) devices, non-invasive arterial saturation (SpO_2), non-invasive end-tidal carbon dioxide ($EtCO_2$) and non-invasive temperature, which should be attached to the neonate. Monitoring equipment should be positioned facing the paramedic and be within hands-reach of the transfer team members.

It has been recommended that to maintain a continuum of care, the standards of monitoring and clinical management should be equivalent to a neonatal intensive care unit environment (13). Any changes or interventions in the neonate's condition should be documented and handed over to the referring personnel and the emergency management communication centre should be kept updated. The minimum standards require that neonatal monitoring by appropriate trained personnel occur: ECG monitoring; NIBP; SpO_2; $EtCO_2$; and non-invasive temperature monitoring (39,40). More recently the Health Professionals Council of South Africa partnered with the African Federation for Emergency Medicine, through which a working group developed the first African evidence-based clinical practice guidelines. Its scope which included paediatric and neonatal resuscitation should be used to guide neonatal transfers, particularly clinical emergencies (38,41).

Participants also reported that the "bumps" during the transport process suggests the need for equipment to be secured to prevent loose items from becoming missiles during sudden acceleration or deceleration of the vehicle or because of g-force or turbulence of the aircraft. Whyte and Jefferies (19) added that equipment not be left on top of a neonate or the incubator and that guidelines should allow easy access for the airway and intravenous lines. In addition, gas cylinders should be securely housed and within easy reach of the attendants. Most importantly, the incubator should be firmly secured to prevent the neonate and equipment from movement that may be harmful.

Carreras-Gonzalez and Brió-Sanagustin (12) noted that clinical management of a neonate in aeromedical transfer differs from ground transport because of the change in altitude and limited cabin space. Aeromedical personnel should therefore have a higher level of expertise, specialist knowledge and practical training, and meet minimum aviation requirements. An increase in altitude affects the neonate's physiology in a number of ways: a decrease in barometric pressure results in reduced alveolar pressure of oxygen (decrease in the partial pressure of gases) and may lead to hypoxaemia, making increased inspired oxygen concentration mandatory for all aeromedical transfers; decreased barometric pressure leads to an increase (expansion)

in the volume of gas filled cavities in the neonate, such as the pneumothorax, therefore the pneumothorax must be drained; and a change in altitude lowers environmental temperature, resulting in hypothermia. In addition to the physical challenges associated with air transfers, similar to those in ground transfers, ALS paramedics need to be prepared with the additional physiological issues that may affect air transfers of clinically ill neonates.

Sub-theme 5: Handover at the receiving hospital
Participants suggested that there should be a formal handover from the team leader of the transport team to the doctor who would assume responsibility for the neonate's care.

> "It is pretty frustrating when the receiving doctors, nurses or facilities are inadequately prepared for us, occasionally the ward where we we're to be going to don't even know that we are coming." [ALS, focus group]

> "The doctor must take over in front of you and you can clarify any concerns." [ALS, focus group]

Acosta et al (42) advised that a physical examination be undertaken by the receiving personnel in the presence of the transfer team leader and that vital signs and findings on handover be documented on the neonatal transfer report form. Documents for the handover should include the neonate's history, vital signs and interventions, significant clinical events during transport, documentation and specimens. This must be duly signed by the receiving personnel and a copy forwarded to the receiving facility, together with a satisfaction or complaint form for feedback and clinical governance.

In the United States, Foronda et al (43) reviewed the handovers at John Hopkins Hospital and noted that handover procedures are both verbal and written, and include all events preceding the reception phase and the neonate's history, vital signs, significant clinical events during transport, interventions conducted, specimens obtained and other relevant documentation.

Finally, there should also be debriefing procedures for the team members and opportunities to discuss issues of concern.

Conclusion

This study shed valuable light on some of the challenges faced by ALS paramedics before and during the transfer of critically ill neonates. It highlighted the need for an integrated standardised approach to transfers nationally in South Africa, and that dedicated specialised neonatal units and transfer teams should be created to affect such transfers. It highlighted the lack of sophisticated equipment and the plight of paramedics caught up in emergency transfers where equipment was either unavailable or malfunctioning. Of significance was that incubators were found to be malfunctioning during transfers and the lack of monitoring equipment constituted additional threats to the safe transfer of critically ill neonates. Adequate neonatal documentation, information regarding the clinical procedures performed before the departure as well as a thorough approach to examination, emerged as crucial before the transfer. The hazards of transfer (by air and road) was further evidenced, particularly the effect on monitoring equipment and the stability of incubators. In its totality the study sketched a rich portrait of the challenges associated with neonatal transfers in South Africa. It calls for a deeper exploration of how stakeholders (ie. policy makers, EMS managers, hospital authorities) must respond to the diverse and complex issues that jeopardise neonatal life within the transfer process and a commitment to prioritise these issues urgently.

Limitations

The study presented the voices of selected ALS paramedics rather than all paramedics nationally with regards to the multiple issues they experienced during neonatal transfers and their suggestions for a more improved system. This was done with a small sample as is acceptable within qualitative research designs. A survey using a quantitative approach with a larger sample may serve to support the findings made.

Competing interests

Pradeep Ashokcoomar was the primary researcher for this study. Mr Ashokcoomar died in January 2019. He was not involved in the authorship of this article.

References

1. Hunter D, McCallum J, Howes D. Compassion in emergency departments. Part 2: barriers to the provision of compassionate care. Emerg Nurse 2018;26.
2. Hennink M, Hutter I, Bailey A. Qualitative research methods. SAGE Publications Limited; 2020.
3. Braun V, Clarke V, Hayfield N. A starting point for your journey, not a map: Nikki Hayfield in conversation with Virginia Braun and Victoria Clarke about thematic analysis. Qual Res Psychol 2019;1-22.
4. Tutty IM, Rothery MA, Grinnell RM. Qualitative research for social workers: phases, steps and tasks. Boston, Mass: Allyn and Bacon; 1996.
5. Liamputtong P, Ezzy, D. Qualitative research methods. South Melbourne: Oxford University Press; 2005.
6. Guba EG. Handbook of qualitative research. New York, NY: Sage Publications; 1994.
7. Buetow S. Apophenia, unconscious bias and reflexivity in nursing qualitative research. Int J Nurs Stud 2019;89:8-13.
8. Wiegersma JS, Droogh JM, Zijlstra JG, Fokkema J. Quality of interhospital transport of the critically ill: impact of a mobile intensive care unit with a specialized retrieval team. Crit Care 2011;15:2-8.
9. Barfield WD, Krug SE, Kanter RK, Gausche-Hil M, Brantley MD. Neonatal and pediatric regionalized systems in pediatric

emergency mass critical care. Pediatr Crit Care Med 2011;12:128-34.
10. Kage A, Akuma A. Audit on central newborn network transport documentation. J Paediatr Child Health 2012;48(Suppl 1):278.
11. Miller A, Novak L, Weinger M, Buerhaus P. Processes and support tools for interhospital neonatal patient transfer: a preliminary study. Sage Journals 2008;52:865-9.
12. Carreras-Gonzalez E, Brió-Sanagustin S. Prevention of complications in the air transport of the critically ill paediatric patient between hospitals. Ann Pediatr 2014;81:205-11.
13. Parmentier-Decrucq E, Poissy J, Favory R, et al. Adverse events during intrahospital transport of critically ill patients: incidence and risk factors. Ann Intensive Care 2013;3:1-10.
14. McEvoy CG, Dscloux E, Schuler M, et al. Evaluation of neonatal transport in Western Switzerland: a model of perinatal regionalization. Clin Med Insights Pediatr 2017;11:1-7.
15. Droogh JM, Smit M, Hut J, et al. Inter-hospital transport of critically ill patients: expect surprises. Crit Care Med 2012;16:26.
16. Blakeman TC, Branson RD. Inter-and intra-hospital transport of the critically ill. Respiratory Care 2013;58:1008-23.
17. Baird JS, Ravindranath TM. Out-of-hospital noninvasive ventilation: epidemiology, technology and equipment. Pediatric Report 2012;4:64-7.
18. Karlsen KA, Trautman M, Price-Douglas W, Smith S. National survey of neonatal transport teams in the United States. Pediatrics 2011;128:685-91.
19. Whyte HEA, Jefferies AL. The interfacility transport of critically ill new-borns. Paediatr Child Health 2015;20:265-75.
20. Woodward GA, Insoft RM, Kleinman ME. Guidelines for air and ground transport of neonatal and pediatric patients. 3rd edn. Elk Grove Village Illinois: American Academy of Pediatrics; 2007.
21. Jackson L, Skeoch CH. Setting up a neonatal transport service: air transport. Early Hum Dev 2009;85:477-81.
22. Kue R, Brown P, Ness C, Scheulen J. Adverse clinical events during intrahospital transport by a specialized team: a preliminary report. Am J Crit Care 2011;20:153-62.
23. Gente M, Di Lallo D, Franco F, et al. Stabilisation of the critically ill neonate awaiting transport. J Pediatr 2015;41(Suppl 1):A15.
24. Chang ASM, Berry A, Sivasangari S. Specialty teams for neonatal transport to neonatal intensive care units for prevention of morbidity and mortality. Cochrane Database Syst Rev 2008;(4):CD007485.
25. Ohning B. Transport of the critically ill newborn. e-medicine. Pediatrics 2008.
26. Hiroma T, Ichiba H, Wada K, et al. Nationwide survey of neonatal transportation practices in Japan. Pediatr Int 2016;58:311-3.
27. Singh A, Duckett J, Newton T, Watkinson M. Improving neonatal unit admission temperatures in preterm babies: exothermic mattresses, polythene bags or a traditional approach. J Perinatol 2010;30:45-9.
28. Bouchut JC, Van Lancke, E, Chritin V, Gueugniaud PY. Physical stressors during neonatal transport: helicopter compared with ground ambulance. Air Med J 2011;30:134-9.
29. Romano E, Kaufmann M. Abstract: Quantification of vibration forces experienced by the newborn during ambulance transport. ibid. 2012;31:167-8.
30. Gajendragragadkar G, Boyd JA, Potter DW, et al. Mechanical vibration in neonatal transport: a randomized study of different mattresses. J Perinatol 2000;20:307-10.
31. Loh E. Doctors as health managers: an oxymoron, or a good idea? Journal of Work-Applied Management 2015;7:52-60.
32. Craig R, Moxey L, Young D, Spenceley NS, Davidson MG. Strengthening handover communication in pediatric cardiac intensive care. Paediatr Anaesth 2012;22:393-9.
33. Horowitz R, Rozenfeld RA. Pediatric critical care interfacility transport. Clin Pediatr Emerg Med 2007;8:190-202.
34. Ashokcoomar P, Naidoo R. An analysis of inter-healthcare facility transfer of neonates within the eThekwini Health District of KwaZulu-Natal, South Africa.
35. Mgcini DT. The quality of neonatal inter-facility transport systems within the Johannesburg Metropolitan Region. Masters of Medicine, University of Witwatersrand; 2011.
36. Gunz AC, Dhanani S, Whyte H. Identifying significant and relevant events during pediatric transport: a modified Delphi study. Pediatr Crit Care Med 2014;15:653-9.
37. Grosek S. Air and ground transport of critically ill neonates and infants in Slovenia. Department for Pediatric Surgery and Intensive Care, University Medical Center Ljubljana 2007;88-91.
38. McCaul M, Hendricks L, Naidoo R. Prehospital providers' perspectives for clinical practice guideline implementation and dissemination: strengthening guideline uptake in South Africa. PloS One 2019;14:e0219761.
39. American Heart Association, European Resuscitation Council and International Liaison Committee on Resuscitation. International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. 2010. Available at: www.circ.ahajournals.org/cgi/content/full/122/18
40. Duff JP, Topjian A, Berg MD, et al. American Heart Association focused update on pediatric advanced life support: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2019:138:e731-9.
41. McCaul M, Clarke M, Bruijns SR, et al. Global emergency care clinical practice guidelines: a landscape analysis. Afr J Emerg Med 2018;8:158-63.
42. Acosta CD, Kit Delgado M, Gisondi MA, et al. Characteristics of pediatric trauma transfers to a level I trauma center: implications for developing a regionalized pediatric trauma system in California. Acad Emerg Med 2010;17:1364-73.
43. Foronda C, Van Graafeiland B, Davidson P. Handover and transport of critically ill children: an integrative review. International Journal of Nursing School Studies 2016;62:207-25.