

THAMES VALLEY & WESSEX NEONATAL OPERATIONAL DELIVERY NETWORK

Guideline for consideration of Noise on the Neonatal Unit.

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| Implications of race, equality & other diversity duties for this document | This guideline must be implemented fairly and without prejudice whether on the grounds of race, gender, sexual orientation or religion. |

Guideline Framework of Consideration of Noise

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| 1.0 | Guideline Framework | |

To provide a framework to ensure that all premature infants, particularly those below 28 weeks gestation, whose 'hearing apparatus' is not fully formed, are not exposed to adverse noise levels.

2.0 Scope of Guideline Framework

The guideline applies to all babies receiving care within Thames Valley & Wessex Neonatal Operational Delivery Network.

| Thames Valley | |
|--|--|
| Buckinghamshire Healthcare NHS Trust | - Stoke Mandeville Hospital, Aylesbury |
| Frimley Health NHS Foundation Trust | - Wexham Park Hospital, Slough |
| Milton Keynes University Hospital NHS Foundation Trust | - Milton Keynes General Hospital |
| Oxford University Hospitals NHS Foundation Trust | - John Radcliffe Hospital, Oxford |
| Royal Berkshire NHS Foundation Trust | - Reading |
| Wessex | |
| Dorset County Hospital NHS Foundation Trust | - Dorset |
| Hampshire Hospitals NHS Foundation Trust | - Basingstoke |
| Hampshire Hospitals NHS Foundation Trust | - Winchester |
| Isle of Wight NHS Trust | - St Mary's Hospital |
| Poole Hospital NHS Foundation Trust | - Poole Hospital |
| Portsmouth Hospitals NHS Trust | - Queen Alexandra Hospital |
| Salisbury NHS Foundation Trust | - Salisbury |
| University Hospital Southampton NHS Foundation Trust | - Princess Anne Hospital |
| Western Sussex Hospitals NHS Foundation Trust | - St Richard's Hospital, Chichester |

3.0 Guideline Summary.

- A neonatal unit is very loud, both the background noise levels and the transient peak noises, this means sick and preterm babies are exposed to continuous and high level noises.
- This exposure to adverse noise levels can affect the neonate through hearing-loss, sleep disturbance, inducing physiological changes (ie raised blood pressure, apnoea or bradycardia), and by noise affecting auditory perception and/ or emotional development.

- The American Association of Paediatrics has identified guidelines for maximum acceptable noise levels on the Neonatal Intensive Care Unit. These are;
 - Up to a maximum of 45dB of sound in the Macro environment (the background sound levels in the general nursery environment.)
 - Up to a maximum of 65dB of sound in the Micro environment (the acceptable transient noise levels that may occur specifically and necessarily in the area directly around the baby.)
- All neonatal units should be striving to reduce the noise levels on their unit, both by promoting and facilitating best practice for noise, but also by consideration of noise when building and furnishing units and when purchasing equipment.
- Ways to limit excess noise – for staff and parents/ families.
 - Reduce talking volume to a low level, particularly when directly by the cot space.
 - Respond rapidly to alarms and other noises such as crying babies
 - Open and close incubator port holes, doors, drawers and disposal bins with care.
 - Keep the alarm volume on monitors as low as possible.
 - Use thick drapes to cover incubators.
 - Use adequate bedding in an incubator- it helps to absorb sound and reduce reverberation.
 - Do not use recorded music or voices for preterm or unwell neonates nursed on the Neonatal Unit.
- Silence is not golden! Exposure to speech and language is healthy and necessary for development.
- Remember to open incubator port holes when talking to the baby- to reduce noise distortion.
- Ear muffs are only recommended during short sound exposure- ie transport or MRI- as may damage skin or damage developing ear structure if left in place long term.
- Staff also work better, make less mistakes and have less accidents when it is quieter!
- Babies who are well and are indicating that they are ready to receive new sounds experiences/stimulation may enjoy;
 - Being sung to.
 - Having a story read to them.
 - Soothing voice when settling to sleep.
 - Toys with noise (rattles, musical mobiles).

4.0 Background Information

Medical literature identifies four main ways in which exposure to adverse noise levels can affect the neonate.

4.1 Hearing Loss

Excessive/abnormal noise exposure has been found to cause physical changes to the baby's developing cochlear. Research has also found abnormal neural organisation in the areas of the brain used for hearing, which it is believed were due to inappropriate and/or excessive noise exposure. Both these changes can then cause varying levels of hearing loss to the 'NICU graduate'.

4.2 Sleep Disturbance

Sleep is fundamental for growth and repair. Studies have shown that in utero a foetus is in deep sleep for 80% of the time. However, within Neonatal Units a neonate's sleep is interrupted very frequently (one study showed an average of 132 times). Noise is one of the major factors contributing to these disruptions in sleep.

4.3 Physiological Changes

Loud sound can cause physiological changes in vulnerable neonates, especially neonates below 35 weeks gestation who cannot habituate to sounds. These include;

- heart rate increase
- swings in intracranial pressure
- increased blood pressure
- altered breathing patterns, includes apnoea causing hypoxaemia
- body chemistry and brain activity changes (raised cortisol and lowered immunity)
- increased energy use

4.4 Auditory Perception and Emotional Development

Speech delay and language related problems are more common in preterm infants. It is believed that one contributory factor for this is the 'atypical sound exposure' they receive at critical periods, which then affects auditory system development. For example; the sound they hear may be distorted through the incubator walls, also the high levels of environmental noise on a Neonatal Unit may interfere with the baby's ability to isolate his/her parent's voice. A preterm baby also misses out on the sound experiences of being in the womb to term. For example, in utero a foetus is hearing and processing sound from 5 months and by birth is able to discriminate between its mother's voice and another female.

It is not fully understood which specific sounds or noise levels may cause harm to the developing hearing system. However, it is clear that 'normal' sound experiences are important for all developing babies (in or ex utero) to ensure the development of a healthy brain structure and in particular its auditory pathways.

4.5 Sound Levels

Sound loudness as perceived by the human ear is expressed using the unit value known as the decibel (dB). Decibels are a ratio of sound pressure using a logarithmic scale, which means simply that an increase in noise by 20dB is a tenfold increase in sound pressure. Humans can hear sound levels between 0dB and 120dB, with a whisper being about 30dB, normal conversation 45-50dB, closing the incubator portholes 80dB and rock music 120dB.

When the sound levels on Neonatal Units are measured they are found to vary between 50-90dB. The American Association of Paediatrics has identified guidelines for maximum acceptable noise levels on the Neonatal Intensive Care Unit. These are;

- Up to a maximum of 45dB of sound - i.e. the background sound levels in the general nursery environment.
- Up to a maximum of 65dB of sound - i.e. acceptable transient noise levels that may occur specifically and necessarily in the area directly around the baby. Such as the monitor alarm tone.

It should be noted that these values were not based on evidence specific to the noise limitation needs of the neonatal population. Instead they were based on the level of sound deemed necessary to enable 100% speech intelligibility, but considered to minimise annoyance to patients and disturbance of clinical activities. (Knutson, 2013)

Research has identified that the average sound level inside an incubator (when there are no other sources of sound) is 58dB, so for the majority of sick babies in the Neonatal Unit they are continually being exposed to higher than recommended sound levels. This research identified that the incubator may offer some protection from sound occurring in the external environment, (5-18dB less) particularly low frequency sounds, such as conversations in the external environment. However, higher pitch sounds like alarms permeate freely into the incubator.

It has also been identified that sounds generated within the incubator are actually amplified for the infant occupant. For example the noise level of CPAP is 64dB within the incubator, but 55dB in an open incubator.

The physical environment of the NICU does play a role in the sound levels experienced by infants, for example infants may be nursed in open cot areas or individual rooms, also the design of Unit will have an effect on the acoustic levels. The kind of flooring installed on a Neonatal Unit, or the insulating properties of the ceilings and walls will also play their part. These aspects should be considered when resigning or refurbishing Neonatal Units.

Table showing actual measured noise levels in a Neonatal Unit

| Source of Noise | Sound Level in dB |
|---|-------------------|
| Pulse oximeter alarm | 65dB |
| Infusion pump alarms | 78dB |
| Blood pot tapping on top of incubator | 80dB |
| Shutting incubator door- without using soft close catch | Up to 100dB |
| Suction tubing - fluid swinging back and forth | 78dB |
| Telephone ring | 65dB |
| Conversation | Up to 80dB |
| Shutting incubator drawer | 77dB |

5.0 Practice Guidelines

5.1 General Principles

- Reduce talking volume to a whisper/low level when directly by the cot.
- Radios and televisions must not be used in the nursery.
- Staff should respond rapidly to alarms and crying babies.
- All staff should open and close incubator port holes, doors, drawers and disposal bins with care. Parents and visitors should be educated to do this.
- Turn off suction after use, to prevent a constant background 'hum' near to the baby.
- Keep the alarm volume on monitors as low as possible. It may be necessary to alter the volume at different times of day. (For example may be turned down at night when there are generally less personnel on the unit.)
- Do not lean on the incubator roof or walls (especially when writing) as these sounds are amplified.
- Extraneous equipment should not be housed in clinical areas, e.g. printers, fridges, centrifuges.
- Staff, parents and visitors should conduct conversation and Unit Ward Rounds away from incubators/cots or outside the care giving area if possible.
- Utilise 'quiet' signs to raise staff and parent awareness of the need to control environmental noise.
- Unit staff should monitor noise levels inside and outside of incubators periodically to ensure limits set by AAPM are not exceeded.
- Staff should be aware that some locations in the nursery are noisier than others (i.e. near sink/door). Whilst staff should aim to keep noise as low as possible in all areas, staff should consider placing the sickest babies in the quietest places.

5.2 Equipment

- Objects should not be placed on top of incubators. Instead utilise nursery cupboard surfaces, attach shelves to incubators or radiant warmers, utilise mobile trolleys or incubator drawers/cupboards. If none of these options is possible staff must place a noise insulating mat between the equipment and the incubator surface. The equipment should then be relocated as soon as possible.
- Use thick drapes to cover incubators (especially at the baby's head end), providing a padded barrier/surface to reduce environmental noise.
- Use adequate amounts of bedding for babies nursed in incubators, as the bedding can absorb some sound and reduce the incidence sound reverberation.
- If any equipment is noted to be making a louder noise than 'usual', stop using this equipment immediately and send for servicing.
- When considering the purchase of new equipment, the level of noise produced by the equipment should be ascertained. The quietest equipment should be selected whenever possible.

5.3 Appropriate Noise

- Encourage all parents and staff to open incubator portholes to speak to the baby. This will help to reduce distortion of the voice through the incubator walls.
- All babies may benefit from hearing gently spoken words and/or singing. However, staff should be guided in their use by the baby's sleep state, behavioural cues and responses. A baby's

noise preferences and tolerances should be recorded in the care plan to guide parents and other staff.

- Do not use recorded music or voices for preterm or unwell neonates nursed on the Neonatal Unit. These will only add to the noise level of their environment. In addition, recorded voice/music does not respond to the baby's cues or changes in state and tends to be repetitive.
- Research studies have found recorded maternal sounds can 'influence the physiologic state of infants in the NICU'. However it is currently unclear how or if such sounds should be utilised in practice, to gain the possible benefits from exposure, without giving unnecessary stimuli and causing extra stress.
- Post term babies who are well and are indicating that they are ready to receive new sounds experiences/stimulation may enjoy;
 - Being sung to.
 - Having a story read to them.
 - Soothing voice when settling to sleep.
 - Toys with noise (rattles, musical mobiles).
 - The responses of other babies in the room should be considered.
- Recorded music should never be used as an easy substitute for more appropriate interaction.

5.4 'Quiet Time' and 'Bed Time'

- Quiet Hour or Quiet Time, is in the daily schedule of many Neonatal Units. This is a predetermined time slot, often 1-2 hours in length, where lights are dimmed, noise reduced and routine procedures postponed. This time is felt to be an opportunity for infants to have a rest from procedural handling, an opportunity for good quality sleep, a chance to reduce babies stress and promote healthy brain and sensory development and a time where infants can spend undisturbed quiet time with their parents.
- It is not intended that quiet time, is the only time the Unit is quiet, but that the Unit always strives to be quiet, but makes even more effort to do so, during this designated 'quiet time'. This time could be thought of as 'Quieter Time'.

General principles of quiet time usually include;

- Closing blinds and lowering lighting levels.
- Keeping noise levels to a minimum.
- Allowing parents and siblings to visit,(and other visitors according to local restrictions.)
- Not performing routine procedures and rearranging care giving to avoid this time period.
- No cleaning to be carried out.
- No Doctors Rounds to be held in the room.
- Posters will be displayed on nursery doors during quiet time, to remind all those entering the Unit.
- Parents may be encouraged to arrive on the Unit before quiet time, and have their baby out for kangaroo care 15 mins before quiet time begins, so they can gain the full benefit from this time.
- If the commencement of quiet time is delayed, this does not have to mean that the 1 or 2 hours scheduled is reduced, there should be flexibility in the routine, to enable quiet time to continue past the usual time.

- If a Neonatal Unit is laid out with more than one individual nursery, then quiet time can be individualised to the needs of that room and its' infants and parents on that particular day.
- If a baby is unstable and is required to have procedures performed during the scheduled quiet time, it is possible that this infant can have 'their own' quiet time, after the procedures are performed, even if on this day, it is out of schedule with the other babies in the room.

Some Units have also adopted the principle of 'Bed Time', where they turn the lights down and try to handle the babies as little as possible after a certain time of night. For example, between 11pm and 5am (22:00 to 05:00 hours) routine procedures are not performed, such as blood tests, weighing babies, medical examinations or planned procedures such as siting central lines.

These rules can be flexible, where the clinical or safety need is a priority, and are not intended to restrict parents from interacting with their babies, some of whom may only be able to visit during night time hours.

5.5 Resources

- Neonatal Units have a responsibility to provide equipment and resources that will enable staff and parents to control noise levels to the sick and preterm infant. Useful resources are likely to include;
 - Incubator covers.
 - Ear muffs and/or ear plugs.
 - Sound measuring devices with visual display for alerting staff to sound levels i.e. Sound Ear.
 - Access to noise monitoring equipment (possibly via Audiology department).
 - Silent closing bins.
 - Monitors with volume control for audible alarms.
 - Telephones with volume control and visual flash setting to replace ringer.
 - Access to clinical engineering services, for regular servicing of equipment and rapid repair of faulty or 'suddenly noisy' equipment.

5.6 Staff

- All staff should receive information and training about noise exposure on the Neonatal Unit, during their orientation to the Unit. This may be in the form of self-directed learning, e-learning or formal training sessions. Ideally staff should be attaining an agreed level of competence which is documented and retained for the records.
- Nurses and Nursery Nurses also need to take responsibility for keeping their knowledge and practice around noise up to date, although they should be facilitated by their work place to do so; For example they may be directed towards practice guidelines, developmental care leads, e-learning, internet resources, current literature, etc.
- Increased staff awareness of noise and it's potentially negative impact on NICU residents is felt by researchers to be one of the key tools to minimising noise levels in NICU. This is because staff are able to affect a significant proportion of the sources of noise. For example conversation, incubator doors, answering alarms promptly, teaching and role modelling parents and new colleagues.

- Staff should also note that higher noise levels on a unit are also associated with higher error rate and accident rate for staff and a generally lower standard of staff performance. So staff can also benefit from reduced noise exposure.

5.7 Parents

- Parents should be informed about the need to consider noise levels and protect their baby from exposure to excessive loud noise, whilst on the Neonatal Unit. They can be supported to be involved in this process, for example teaching them how to close incubator doors silently, encouraging them to provide positive sounds to their baby - such as singing, talking or reading to their baby.
- Take care to offer parents consistent information about noise, as many parents identify receiving inconsistent information is one of the biggest challenges of having a baby on the Neonatal Unit. Parents can be directed to sources of information about noise, such as the Network Parents Information APP, Bliss Information booklets and relevant internet websites.
- Parents should be given information about 'Quiet Times' and 'Bed Time' where appropriate, and encouraged to be and feel a key part of the team caring for their baby.

5.8 Audit

- Neonatal Unit practice around noise exposure of sick and preterm infants should be audited as per local audit policy. All staff should contribute to this process when required. This is most likely to be by completing an audit document or benchmarking questionnaire.

6.0 Parent's Information Leaflet



Noise on the Neonatal Unit: A Parent's Guide.

- The Neonatal Unit can be a noisy place, with some **very loud** noises, due to alarms ringing and equipment noises. There can also be **constant** noise from the sound of lots of people working and talking twenty four hours a day.
- Babies are not strangers to noise. In the womb, babies are hearing and responding to sound from 5 months (including voices, music, maternal heartbeat and bowel sounds). However, they are protected from many outside/loud noises and are in a safe and supportive place. Also they will have rests from noise when the mother is sleeping.
- From research we now know that premature babies and sick babies find these noises in a Neonatal Unit stressful and unpleasant.

- The noise may wake them up before they are ready, or stop them sleeping at all.
- Babies find it harder to stay in deep sleep, where they grow and heal best.
- Babies hearing may be damaged.
- Some babies are startled by the sudden noises, causing their breathing, blood pressure or heart beat to jump higher or lower than 'normal'.
- Babies may find it hard to hear, learn and enjoy 'nice noises' like a parent's voice.

There are a number of simple things we can all do to reduce noise and support sick or preterm babies.

- Learn to be aware of noise and keep voices low around your baby.
- Try to open and close incubator doors quietly instead of snapping them shut.
- Try not to put anything down on top of the incubator.
- During quiet hour, when your baby is asleep and at night time, make a special effort to keep noise down.
- You are welcome to be present during quiet time. It is helpful if you are able to arrive before it begins and stay until it is over, as this will help keep the unit calm and quiet. If your baby is well enough, then quiet time is an excellent opportunity to get your baby out for kangaroo care, and benefit fully from the peaceful atmosphere.
- Use a thick cover over baby's incubator to help muffle noise.
- Be generous with the bedding inside an incubator, it helps to absorb noise and reverberations, hopefully improving the baby's experience.
- If the nursery seems particularly noisy, speak to the staff about your concerns, they may be able to help.
- When possible move away from fragile babies to have conversations.
- Open the incubator portholes when talking to your baby - to reduce the distortion of your voice through the incubator walls.
- Speak to your baby in a quiet, gentle, soothing voice, so they can learn to enjoy your voice.
- Your baby may enjoy singing or having a story read to them.

- While your baby is in hospital we do not recommend recorded music or voices. This is because they do not respond to the baby's cues or changes (i.e. crying), the noise tends to be repetitive and also makes the room even noisier for the other babies.
- Try to notice how your baby responds to different noises, so that we can learn about what he likes or dislikes and make changes to his care. (For further information explaining how your baby is communicating with you, please ask you baby's nurse for a free copy of the booklet 'Look at me I'm talking to you'.)

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