The role of physiotherapy in the neonatal intensive care unit has historically been mainly associated with the care of the neonate's lungs. Postural drainage coupled with percussion, vibrations and suction are all used in the physiotherapy management of neonatal respiratory disorders. At Monash Medical Centre all elective extubations are performed by the physiotherapist in accordance with the neonatal unit’s protocol: this includes four hourly respiratory physiotherapy for the first 24 hours after extubation to ensure that post-extubation atelectasis does not occur. In addition to respiratory care, the physiotherapist is also engaged in the assessment and management of neonates with either neurological or musculoskeletal disorders.

Nicolina Bertone, B.App. Sc. (Phty), is Deputy Chief Physiotherapist at the Monash Medical Centre, Clayton, Victoria.

Over the last decade physiotherapy has become an acknowledged and often integral part of the management of newborn infants in neonatal intensive care units around the world. It is a well-established practice to refer sick neonates with respiratory problems for physiotherapy, however, this is not the only area in which physiotherapy has a role. Physiotherapy is also indicated in neonates with both neurological and orthopaedic problems. At Monash Medical Centre the physiotherapist is attached to the neonatal intensive care unit on a full-time basis and the service is provided seven days a week.

Historical Background

One of the earliest published clinical studies on the effect of respiratory physiotherapy on the neonate was undertaken by Holloway et al in 1969. They noted that there was wide alveolar to arterial oxygen pressure gradient and failure to maintain normal arterial oxygenation among patients being ventilated on air by Intermittent Positive Pressure Respiration (IPPR). The authors hypothesized that it was possible to improve oxygenation by opening up areas of atelectasis or removing secretions which block bronchi and that one method of doing this was by means of respiratory physiotherapy. Subsequently a research study was devised and undertaken to test this hypothesis.

The sample size of this study consisted of 51 babies in total and all were given IPPR via a cuffed tracheostomy. One group was used as the control group, another was given hyperinflation and physiotherapy and the third group was given hyperinflation only. Two significant findings were reported:
(1) Partial pressure of arterial oxygen (P02) dropped significantly after respiratory physiotherapy and took one hour to return to normal.
(2) Neither physiotherapy, nor hyperinflation, nor hyperinflation plus physiotherapy restored arterial p02 to normal.

In retrospect many criticisms can be directed at this particular study. For example, all infants in the sample were paralysed with curare and all were mechanically ventilated via a tracheostomy tube, neither of these being routine practice today. All infants were ventilated with air only and no supplemental oxygen was used. In fact the team concluded the study by advising that all ventilated infants be given oxygen during physiotherapy, but did not make any recommendation about ensuring adequate arterial oxygenation at all other times with the judicious use of supplemental oxygen.

During the next seven to eight years very little material was published relating to the topic of respiratory physiotherapy in the neonatal unit. However, in the late seventies interest in the area was renewed and material related to this topic began to appear around the world.

A study designed to measure accurately the amount of secretions removed with respiratory physiotherapy was conducted by Etches and Scott in 1978. The sample size was small con-
Physiotherapy in a Neonatal Intensive Care Unit

sisting of only six infants. The infants acted as their own controls: upper air-
way suction was preceded by physio-
therapy on alternate occasions. After each session of suction a balance ac-
curate to 10 mg was used to determine
the weight of secretions removed. In all cases, the mean weight of secretions
removed after physiotherapy was
greater than that removed by suction
alone (p<0.005).

In that same year Finer and Boyd
designed a controlled study to assess
the effect of respiratory physiotherapy
on preterm infants. The sample con-
cluded of twenty infants who were di-
agnosed as having either Hyaline Mem-
brane Disease, Transient Tachypnoea
or Pneumonia. All infants required
supplemental oxygen to maintain their
arterial PO2 following postural drainage and
percussion with a mean rise of 14.5
mmHg (p<0.001). There was no sig-
nificant difference between the pre-
and post-drainage arterial PO2 (p>0.5).

More detailed research directed to-
wards the effectiveness of various tech-
niques used for respiratory physio-
therapy in the neonate was described
papers published subsequently. In 1979 Curran and Kachoyan attempted to determine the most effec-
tive means of administering respiratory physiotherapy. The sample consisted of six infants diagnosed as having RDS
and their gestational age ranged from
28 to 40 weeks. One set of infants received respiratory physiotherapy for
one minute through a common electric
toothbrush heavily padded to prevent
excoriation of the infants’ skin. The
device was gently guided back and forth
across the thoracic wall. The second
set of infants received respiratory physiotherapy for one minute using a
padded nipple (not described in detail
in the text) which was moved rhythm-
ically by hand across the thoracic wall. A third control group, received no re-
spiratory physiotherapy at all. Blood
gas determinations, heart rate, respira-
tory rate, breath sounds, tissue per-
fusion and activity levels were all mea-
sured before and after the various

Results showed that all infants had an increase in arterial
PO2 following physiotherapy, the mean increase being 20.8 mmHg. There was
a statistical difference (p<0.01) for PO2 between the pre and post-physio-
therapy means, with no difference ob-
erved between pre and post-suctioning
only values.

Finer et al followed up the previous
study with another later in the same
year, this time studying the effects of
postural drainage alone versus postural
drainage and percussion. The aim was
to determine which aspects of respi-
atory physiotherapy were responsible
for the improvement in oxygenation. Twenty newborn infants diagnosed as
having Respiratory Distress Syndrome
(RDS) were admitted to the study. Ten
infants randomly selected received pos-
tural drainage with percussion whilst
the other ten received postural drainage
alone. The results demonstrated a sta-
tistically significant increase in arterial
PO2 following postural drainage and
percussion with a mean rise of 14.5
mmHg (p<0.001). There was no sig-
nificant difference between the pre-
and post-drainage and post-percussion
PO2 (p>0.5).

The conclusion made from this study was that an electric tooth-
brush is more effective in obtaining
secretions. However, it was noted that
respiratory and heart rates as well as
activity level were all raised with this
technique and it also appeared that this
form of physiotherapy may, in fact,
be more stressful to the infant than the
other techniques studied.

Tudehope and Bagley in 1980 set up
a controlled study to assess the effec-
tiveness of various physiotherapy tech-
niques. Fifteen newborn infants were
admitted to the trial and all were on
assisted ventilation for RDS. Each in-
fant received each technique two hours
apart. The order in which the tech-
niques were delivered was randomly
selected. The three techniques studied
were ‘contact heel percussion’ which
was continuously applied using the
hand at a right angle to the infant’s
thoracic wall, cupping with a Bennett
face mask and vibrations with an elec-
tric toothbrush (General Electric). The
results demonstrated that all infants
had an increase in arterial PO2 follow-
ing cupping with a mean rise of 16.6
mmHg (p<0.001). Ten infants had a
rise in PO2 following contact-heel per-
cussion with a mean rise of 5.5 mmHg
(p<0.05). There was no statistical dif-
fERENCE in arterial PO2 before and after
VIBRATION. Transcutaneous PO2 moni-
toring recorded increased PO2 levels for
up to one hour, following ‘contact-
heel’ percussion and cupping. It was
rationalized that both these techniques
loosened secretions in the terminal air-
ways, stimulated lung expansion and
thereby improved ventilation-perfusion
ratios. Tudehope and Bagley con-
cluded that the narrow airways of pre-
mature infants do not allow secretions
to drain without mechanical assistance
in the form of percussion or cupping.
Consequently postural drainage with
active respiratory physiotherapy is re-
quired in all intubated infants with RDS
to break loose secretions and assist out-
ward drainage.

Anatomy and Physiology
Prior to discussing various respira-
tory physiotherapy techniques in detail
a brief discussion of the anatomical
and physiologic differences between adults
and neonates is warranted.
Physiotherapy in a Neonatal Intensive Care Unit

The major differences are:

- A newborn has a high larynx enabling the epiglottis to guide the larynx up behind the soft palate to produce a direct airway from the nasal cavity to the lungs. This causes neonates to be obligatory nosebreathers. They are able also to simultaneously breathe and swallow until two to three months of age (Pang and Melins 1975).
- The ribs of the newborn are positioned horizontally and the intercostal muscles are weak, resulting in a predominantly abdominal or diaphragmatic pattern of breathing.
- The lungs of a neonate are less compliant than those of an adult, however, the thoracic wall is more compliant due to the cartilaginous nature of the ribs and lack of intercostal muscle strength. This difference can lead to an increase in both airways resistance and obstruction. The narrow diameter of the infant’s airway and a weak or absent cough reflex can also lead to airways obstruction.
- The newborn or premature infant is highly susceptible to diaphragm fatigue and compensates for respiratory difficulty by increasing the rate rather than the depth of ventilation.
- The cough reflex in a premature baby is not fully developed until 32-34 weeks gestation.

All these factors, although normal for a neonate, contribute to respiratory distress and possible respiratory failure.

Indications for Respiratory Physiotherapy

The most commonly referred conditions for physiotherapy are hyaline membrane disease (HMD), meconium aspiration, pneumonia, and surgery involving the thorax or abdomen.

The most common cause of respiratory distress in the neonate is HMD which is related to insufficient levels of surfactant in the lung (Farrell and Avery 1975). It is most often associated with prematurity, Caesarean section delivery, maternal diabetes, perinatal asphyxia and shock, and the second born of twins. Symptoms usually appear within two to three hours after birth with progressive deterioration within 24 to 48 hours. Prominent clinical signs include increased respiratory rate, expiratory grunting, intercostal and sternal retractions, nasal flaring and a see-saw pattern of respiration between the chest wall and abdomen. The major pathophysiologic manifestation of HMD is hypoxaemia resulting from perfusion of atelectatic air spaces. The common pulmonary complications secondary to intubation, mechanical ventilation and oxygen therapy, include oxygen toxicity, bronchopulmonary dysplasia (BPD) pneumothorax, pneumonia, sepsis (Storm 1980), increased mucous production, mucous plugging and residual pulmonary disease.

Respiratory physiotherapy for infants with HMD is directed towards prevention of complications that affect airway clearance. Bronchial drainage techniques are begun when signs of atelectasis, infiltrate or uncontrolled secretions are noted clinically or by radiographs. In the intensive care unit at the Monash Medical Centre physiotherapy techniques are commenced at least 72 hours after birth when the recovery phase commences and retention of viscous secretions becomes a problem. Physiotherapy management of the respiratory problems continues until the baby is clinically well and the chest x-ray is clear.

Meconium aspiration results from aspiration of meconium-stained amniotic fluid by the foetus or neonate. It most frequently occurs in full-term, post-mature and intra-uterine growth-retarded infants. Tachypnoea is the most prominent sign of respiratory distress and usually appears within 12 to 24 hours of birth. Infants have a characteristic barrel-chested appearance. Possible complications include bronchiolitis, pneumonitis, cor pulmonale, atelectasis and persistent foetal circulation. Medical management once again is supportive. Antibiotic therapy, assisted ventilation with positive end-expiratory pressure (PEEP) and supplemental oxygen are often used. Physiotherapy commences as soon as possible and includes positioning, percussion, vibration and suctioning. These techniques are continued until secretions are free from meconium and therapy may need to be continued for several days to ensure clearance of the airways and to help prevent secondary lower respiratory tract infection.

Pneumonia may develop at any time during the neonatal period and conditions that increase a neonate’s risk of developing pneumonia include:
- Premature rupture of membranes.
- Intrauterine asphyxia.
- Prematurity.
- Intubation and mechanical ventilation.
- Thoracic and upper abdominal surgery with general anaesthesia.

Crane (1981) recommends that physiotherapy techniques are beneficial in patients with pneumonia and compromised airway clearance, especially in the later, clearing-up stages of the infectious process. For this reason all babies in our unit with pneumonia are given regular chest physiotherapy.

The aims of respiratory physiotherapy are:
- Maintain a clear airway;
- Clear excess or accumulated secretions from the respiratory tract;
- Re-expand collapsed segment/s of the lung;
- Prevent respiratory complications such as atelectasis, infection and retained secretions;
- Maintain adequate levels of oxygenation;
- Improve the general respiratory function of the neonate.

On the other hand, the contra-indications for physiotherapy are:
- Very unstable condition of the baby.
- Severe hypothermia — temperature less than 36.3°C.
Physiotherapy in a Neonatal Intensive Care Unit

- Recent pneumothorax which does not have an intercostal catheter in situ.
- Pulmonary haemorrhage in the presence of fresh blood-stained secretions.

It must be remembered that these are guidelines only and may alter with individual babies. For example, hand-bagging of a child whose condition is unstable during physiotherapy may be necessary if the infant's poor physical condition is due to severe lung disease.

Techniques of Physiotherapy

The techniques that are employed include postural drainage, percussion, vibration and suctioning. Fortunately the cots are so designed that the baby may be tipped according to the traditional postural drainage positions (Figure 1). If, for some reason, the cot will not tip, folded nappies are used to produce the desired tip.

However, there are times when the infant will not tolerate tipping. These include:
- Marked instability of the infant's condition;
- The first 24 hours following abdominal and thoracic surgery;
- Immediately after vomiting large amounts of milk;
- Less than 48 hours after suspected or proven intracranial haemorrhage;
- The presence of an abdominal mass which impedes the downward excursion of the diaphragm, e.g. diaphragmatic hernia;
- Raised intracranial pressure, as may occur in hydrocephalus.

In these cases vibration and/or percussion can still be used. The infant can be placed in the appropriate postural drainage positions without the cot being tipped.

Vibrations and percussion are both used to move secretions in the lung from the smaller to the larger airways and thence to the trachea, especially when used in conjunction with postural drainage. Vibrations consist of a fine shaking of the hand or fingers which are placed over the area of the lung to be treated and are performed during expiration (Figure 2). Vibrations are combined with over-pressure and gentle 'springing' or squeezing of the rib cage at the end of expiration. If the infant has stiff, non-compliant lungs then great care is taken not to do this springing too vigorously as it may cause rib fracture. These techniques are most useful in pushing the loosened secretions along the bronchi to the trachea, and so the pressure of the vibrations and the rib squeezing are done in the direction of the trachea.

Percussion results in a coarse shaking of the underlying tissue and is used to initiate the movement of the secretions to be drained (Figure 3). The most effective method of applying percussion employed in this unit is the Bennetts Face Mask (Puritan-Bennett...
Figure 3: Percussion with Bennett's face mask

Corporation), which all babies have as part of their bagging circuit. A finger is placed in the central porthole and movement is then carried out from the wrist as in traditional manual percussion. The rim is made of soft pliable rubber, so it is not necessary to protect the child with layers of clothing.

Total treatment time is limited to 10 or 15 minutes so as not to handle the infant excessively and inadvertently increase the oxygen demands (Fox et al 1978). Usually two to three minutes is spent treating each affected segment with a maximum of three segments per treatment. If the baby is being fed orally or via a nasogastric tube, physiotherapy treatment is scheduled approximately 15 to 20 minutes prior to a feed and at least 45 minutes after the last feed. In this way the baby is not constantly disturbed and is thus allowed to spend as much time as possible sleeping undisturbed between feeds.

Treatment frequency depends on the severity of the condition and on the infant's tolerance. Two hourly treatment is indicated only in the presence of severe collapse or consolidation of part or all of the lung, or in the presence of excessive secretions which are not being effectively removed by suction alone or by less frequent physiotherapy. Only in exceptional circumstances is this frequency of treatment maintained for longer than 48 hours as it tires the baby excessively.

Four hourly treatment is indicated in the presence of collapse or consolidation of part of the lung or if the secretions are accumulating rapidly and are not being removed effectively by suction alone. In fact, most babies with acute conditions are commenced on four hourly treatment and their respiratory status continually re-assessed. Six or eight hourly treatment is used when the condition is resolving and only small to moderate amounts of secretions are being aspirated.

Normally, secretions from each segment are removed by suction as clearance of each is completed. Suction is either via the oropharynx in non-ventilated infants or the endotracheal tube (ETT) in ventilated infants. A sterile technique is used in ventilated infants ensuring that the catheter is not attached to the suction as it is being threaded into the ETT. Suction is maintained as the catheter is being withdrawn with only 10-15 seconds being allowed for this manoeuvre. It is suggested that suction pressure not exceed 200 mmHg with the optimum being between 100 to 150 mmHg (Poole et al 1974). At the end of the treatment the nasopharynx is suctioned in non-ventilated infants. However, prior to this, it is vital to ensure that the oropharynx has been cleared totally as nasopharyngeal suction will often stimulate a deep inspiration. If secretions have pooled in the oropharynx these may be aspirated into the respiratory tract. For intubated infants the sequence for suctioning is ETT first, followed by the oropharynx and the other nares. Amount, consistency and colour of all secretions aspirated is recorded on the infant’s ventilation chart as is the need for increased oxygen or handbagging during physiotherapy treatment.

All catheters have a Y-connection so that suction may be controlled at all times. Depending on the diameter of the ETT, various size catheters are indicated. Young (1984) recommends that catheters should be less than half the diameter of the trachea. Thus, at the Monash Medical Centre Size FG5 catheters are used for 2.5mm ETT, Size FG6 for 3.00mm ETT and Size FG8 for 3.5mm ETT.

Suctioning is used at other times as well as in conjunction with physiotherapy treatment. It is carried out routinely every four hours on all ventilated infants as part of the nursing care. During routine suctioning a lavage consisting of 0.5 mls normal saline is instilled into the ETT to help prevent tube blockages as advocated by Drew et al (1986). If the infant shows signs of excessive secretions and is obviously distressed, the frequency of suctioning may be increased as the need arises.
Extubations

All extubations except those classified as emergencies are performed by the physiotherapist. Example of emergencies include a blocked ETT or accidental removal by the infant. The rationale for this routine is based on the findings of Finer et al (1979). These authors reported on a retrospective review of post-extubation atelectasis. Finer et al noted that in previous reports up to 50 per cent of intubated neonates weighing less than 1250 gm required re-intubation because of the complication of post-extubation atelectasis. The Finer study found that eight of twenty-one infants receiving no physiotherapy developed post-extubation atelectasis. Of these eight, seven required re-intubulation because of right upper lobe or right lower lobe atelectasis. Only one of twenty infants receiving physiotherapy developed atelectasis post-extubation and this infant did not require re-intubation.

At the Monash Medical Centre extubation is timed at least 45 minutes after the last feed. The infant receives appropriate respiratory physiotherapy just prior to extubation. The treatment session is directed towards clearing all segments of the right upper lobe. Suction is applied in the usual manner at the end of clearing each segment. Before the tube is withdrawn the oropharynx and other nares are cleared of all secretions. The tube is then withdrawn with a suction catheter in situ. At the same time as both tube and catheter are withdrawn suction is applied ensuring that the limit of 200 mmHg is not exceeded. Oxygen via a face mask is kept close by the infant’s face, the concentration of which is at least 5 per cent greater than that which the infant was receiving from the ventilator. Suction is continued until both oropharynx and nasopharynx are cleared. The infant is placed within a headbox with the appropriate oxygen concentration, and an oxygen monitor and thermometer are placed within the headbox. The infant is then nursed prone with the head up as this position allows better gas exchange and a more synchronous breathing pattern (Hough 1984). The infant receives nil by mouth for at least four hours post-extubation. Prior to recommencing feeds, four hourly physiotherapy is instigated. A postural drainage chart is drawn up and left by the cot side so that the nursing staff may continue physiotherapy overnight. At least one segment of the right upper lobe and right lower lobe is included in each treatment session, as these are the most common sites of post-extubation atelectasis. Chest x-ray and arterial blood gas measurements are taken four to six hours post-extubation to ensure that no atelectasis has developed and that the infant is receiving the correct oxygen concentration. Four hourly respiratory physiotherapy is continued for at least 24 hours post-extubation or until the chest x-ray is clear.

Lobar collapse following extubation of the trachea may occur as a result of retained secretions and mucosal oedema. Frequent intubation may traumatize the airways leading to further damage and a higher incidence of post-extubation complications such as subglottic stenosis. The other major post-extubation complication is the occurrence of tracheal and laryngeal oedema resulting in stridor and upper airway obstruction. Dexamethasone given 24 hours prior to extubation may minimize this occurrence. However, lately, it has been preferred to use a 2.5% solution of racemic adrenaline administered as an inhalation in the post-extubation period (Figure 4). Inhalations of racemic adrenaline normally do not need to be used after the first 24 hours following extubation.
Environmental Stimulation

In the neonatal unit of Monash Medical Centre a strict protocol or policy of environmental stimulation for all preterm infants is not usual. However, each infant’s individual needs are assessed. Close communication is maintained between the neonatologists and physiotherapist so that intervention programmes may be instigated when appropriate for individual children.

Serial cerebral ultrasonography will indicate presence of intraventricular haemorrhage, hydrocephalus, brain cysts or cerebral atrophy and thus simultaneously indicate which infants require earlier or more intense physiotherapy intervention. Nursing staff and mothers are instructed in the handling of these children with special needs.

The environment in a neonatal intensive care unit is not at all similar to that of foetal life. However, some measures can help to make the preterm infant’s extra-uterine life as non-stressful as possible. It is certainly well known and accepted that excessive handling will cause hypoxaemia (Long et al 1980) and so for this reason the babies are allowed to sleep undisturbed for periods of four hours during both day and night. That is, every four hours all nursing care is given including change of position, change of nappy, feed, suction, observations and physiotherapy. In this way the infants are disturbed once every four hours and allowed to sleep with minimal disruptions in between the routine nursing care.

The infants are also nursed on waterbeds to simulate the intra-uterine environment. Komer et al (1975) suggest that waterbeds be used to provide compensatory vestibular stimulation similar in kind to that prevailing in utero. Waterbeds also help reduce the incidence of skin breakdown, asymmetry of head shape and the occurrence of apnoeic periods. The incubators are partially covered so as to reduce the intensity of bright illumination within their environment. Noise level is reduced as much as possible by such means as turning down the sound on monitors and alarms, turning down the tone of the telephones and encouraging the neonatal intensive care unit personnel to keep voice levels low.

As a child is nearing full-term and is medically stable, an individual programme of handling, feeding and stimulation will be commenced. At this stage both nursing staff and mothers are instructed in the programme. However, no strict timetable is devised for the child, but rather a list of requirements is left by the bedside. For example, if a child has feeding difficulties then diagrams and instructions are provided so that the techniques may be continued by the nursing staff at each feed time.

Children who remain in the neonatal intensive care unit well beyond the neonatal period, because of ongoing medical problems, require special attention to promote their motor development. For these infants, periods of stimulation and play are necessary in addition to basic nursing care. Such children may be three to four months of age corrected for the period of gestation. They require stimulation to allow normal maturation of the Central Nervous System in order to minimize possible neuro-developmental deviations which have been well documented in past literature (Burns et al 1982, Burns et al 1984). Baby massage may be taught to mothers and nursing staff especially if the infant is noticed not to either respond to or show signs of pleasure with normal handling.

As the time of discharge approaches, the mothers of these infants who have required prolonged hospitalization will be taught a more intense programme of handling and therapeutic techniques in order to develop confidence in the handling and care of their infant. Special feeding techniques, positioning to help normalize tone, and respiratory physiotherapy are taught to the mothers, if indicated.

If postural deformities or tonal problems are suspected, the mother is introduced to the senior paediatric physiotherapist who then sees both mother and infant on a regular outpatient basis.

Orthopaedic and Musculoskeletal Problems

Fortunately, not many orthopaedic or musculoskeletal problems are seen in the neonatal intensive care unit. The most common of these which do present is talipes equino varus. Strapping is the treatment of choice in the preterm infant with special attention being given to the infant’s skin condition. Rarely are fractures of long bones encountered, but if they do occur, splinting using thermoplastic materials is the treatment of choice. Both these splinting techniques are undertaken by the physiotherapist in charge of the unit.

Occasionally an infant diagnosed as having extremely severe HMD which is requiring unusually high ventilation may be paralyzed electively with Pancuronium (a neuromuscular blocking agent) in order to allow optimal gas exchange and tissue perfusion to occur. In such an event occurring, the nursing staff are instructed in full passive range of movements for each major joint. Daily re-assessment is performed by the physiotherapist who also provides guidance in positioning and handling of these infants.

Contractures may occur occasionally due to malpositioning of limbs in intra-venous splints or from chemical burns from intra-venous drips which have leaked their contents into subcutaneous tissues. Once again the nursing staff are instructed in passive stretching techniques after the infant has been assessed by the physiotherapist. The physiotherapist continues to monitor the infant’s progress and will advise the nursing staff of any change required in the infant’s management.

Conclusion

The aim of this paper has been to discuss the role of physiotherapy in the neonatal intensive care unit in a major
Physiotherapy in a Neonatal Intensive Care Unit

hospital. The majority of the physiotherapist's time is spent treating infants with respiratory disorders. However, the physiotherapist also has a role in offering assessment and management of other problems such as musculoskeletal and neurodevelopmental disorders. The physiotherapist is seen to be an essential member of the neonatal team because of the varied skills brought to the infant's management by this professional.

Acknowledgement

I wish to acknowledge the contributions of my colleagues, the help and support given by Professor V Y H Yu, Director of the Neonatal Intensive Care Unit, during the development of this program.

I am also grateful to Ms Barbara Walker, Chief Physiotherapist, for her advice and encouragement and to Miss Rosemary Cox for her expert secretarial work in preparing this manuscript.

References


Curran LC and Kachoyeas MK (1979), The effects on neonates of two methods of chest physical therapy, Mothercraft Nursing, 4, 309-313.


Farrell PM and Avery ME (1975), Hyaline membrane disease, American Review of Respiratory Disease, 111, 657-668.


Pang LM and Mellins RB (1975), Neonatal cardiorespiratory physiology, Anesthesiology, 43(2), 171-196.


Tudhope DI and Bagley C (1980), Techniques of physiotherapy in intubated babies with the respiratory distress syndrome, Australian Paediatric Journal, 16, 226-228.

Young CS (1984), Recommended guidelines for suction, Physiotherapy, 70, 106-108.