

BEST CURRENT EVIDENCE ON CHEST PHYSIOTHERAPY IN NON-VENTILATED
PAEDIATRIC PATIENTS (0 TO 24 MONTHS) WITH BRONCHIOLITIS: A SYSTEMATIC
REVIEW

by

Ms A. Human

Submitted in fulfilment of the requirements for the degree

MPhysT (Research)

in the

FACULTY of HEALTH SCIENCES (DEPARTMENT OF PHYSIOTHERAPY)

at the

UNIVERSITY OF PRETORIA

Supervisor

Ms K. Mostert-Wentzel

April 2011

Declaration

UNIVERSITY OF PRETORIA DECLARATION OF ORIGINALITY

Anri Human

20090723

Declaration

1. I understand what plagiarism is and am aware of the University's policy in this regard.
2. I declare that this dissertation is my own original work. Where other people's work has been used (either from a printed source, internet or any other source), this has been properly acknowledged and referenced in accordance with departmental requirements.
3. I have not used work previously produced by another student or any other person to hand in as my own.
4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

SIGNATURE OF STUDENT:

SIGNATURE OF SUPERVISOR:

*To YHWE alone be the glory
To YHWE alone be the praise
Everything I say and do
May it be an offering to You*

The glory is Yours alone...

Dedicated to my loving and supportive parents, family and friends



Acknowledgements

I would like to thank the following people for their dedication, help and support of this Master's degree:

- Abba Father, YHWE Elohim. You are my Rock and my Salvation.
- My parents (Henry and Antoinette Human) for their unconditional love, support, motivation and prayers.
- My study leader (Ms Karien Mostert-Wentzel) for her assistance and guidance.
- My colleagues at MEDUNSA, University of Limpopo for their input, assistance and motivation:

Ms Frida Kotsokoane

Prof. Efe Useh

Mrs. Nadia Latib

Ms Kelebogile Montsho

- The library staff at the University of Pretoria (Mrs. Monica Van Schalkwyk and Mrs. Susan Scheepers).
- The graphic designer at the University of Pretoria (Mr. Gert Brits) for the design of the Appendices Computer Disc (CD), as well as technical editing.
- The language editor, Ms R. Scheepers.
- The statisticians:

Prof. H.S. Schoeman (MEDUNSA, University of Limpopo)

Prof. P. Rheeder (University of Pretoria)

- My colleagues, family and friends for all their support and encouragement.
- All the girls at "Prayer and Share", the Bet'Or group and my intercessors for their continued prayers, love and support.

Abstract

Title

Best current evidence on chest physiotherapy in non-ventilated paediatric patients (0 to 24 months) with bronchiolitis: a systematic review.

Purpose

To determine the current scientific evidence for using three chest physiotherapy modalities namely percussion, postural drainage and suctioning in paediatric patients (0 to 24 months).

Relevance

The field of cardiopulmonary physiotherapy seems to be a neglected area in physiotherapy, with a subsequently limited evidence base. The author observed that in various clinical settings physiotherapists tend to administer routine chest physiotherapy to paediatric patients with bronchiolitis. Findings from this study may assist physiotherapists in their choice of effective treatment options.

Sources

The following databases were searched for evidence:

African Health Line, CINAHL, Cochrane, Ebsco Host, Emerald Host, UP E-theses/dissertations, PEDro, Medline Ovid, Sabinet, Science Direct, Up To Date.

Methodology

This was a systematic review. The databases were reviewed by making use of a specified search strategy customised for each database. Keywords were: physiotherapy/physical therapy, bronchiolitis and paediatric/pediatric in combination with percussion, postural drainage and suction. The search yielded 10,016 study titles. Studies were chosen from the population of studies using pre-set inclusion and exclusion

criteria. These criteria were applied to the titles, abstracts and full-text articles as appropriate. Five full text-articles were appraised and based on the scores from the appraisal three were included in the final sample.

Data analysis

Appraisal instruments from the National Health System Critical Appraisal Skills Programme (NHS CASP) and the PEDro scale (for randomised controlled trials) were used to evaluate and score the sample. Scoring was done independently by two researchers, and agreement reached through negotiation. The evidence was synthesised and graded according to the Sackett hierarchy of evidence.

Results

Owing to the heterogeneity of the sample, and the nature of results reported, a meta-analysis was not possible.

Results from this study reveal that there is no evidence to support routine chest physiotherapy in uncomplicated viral bronchiolitis amongst the paediatric population. Chest physiotherapy does not decrease length of hospital stay, oxygen requirements or clinical scores indicating distress/morbidity. However, with secondary bacterial respiratory infections, chest physiotherapy may be indicated, depending on the assessment of each individual patient.

Conclusion

Percussion, postural drainage and suctioning are not effective in the management of bronchiolitis in children, newborn to 24 months old, except in individually assessed cases with secondary bacterial infection. In this subset, physiotherapy must be customised to the patient. Therefore routine physiotherapy is not indicated.

Implications

Chest physiotherapy should be based on a complete evaluation and on clinical merit, as well as on evidence and patient preference. Education of physiotherapy students at universities as well as doctors regarding the current evidence for chest physiotherapy in paediatric bronchiolitis is essential. Doctors and clinicians need to be made aware that routine chest physiotherapy for paediatric patients with bronchiolitis should *not* be prescribed.

Keywords

Viral bronchiolitis
Pulmonary postural drainage
Respiratory bronchioles
Respiratory drainage
Respiratory Syncytial Virus infections
Respiratory therapy
Respiratory infections
Respiratory tract infections
Physical therapy modalities
Physical therapy techniques

Opsomming

Titel

Die beste huidige bewyse aangaande longfisioterapie vir non geventileerde pediatriese pasiënte (0 tot 24 maande) met brongioliitis: 'n sistematiese oorsig.

Doel

Om huidige wetenskaplike bewyse vir die gebruik van drie long fisioterapietegniese naamlik beklopping, posturale dreinasie en suiging in pediatriese pasiënte (0 tot 24 maande) te bepaal.

Toepaslikheid

Die veld van pediatriese fisioterapie blyk 'n verwaarloosde area van navorsing te wees, met gevolglik beperkte bewysbasis. Die navorser het ondervind dat fisioterapeute dikwels in kliniese praktyk roetine longfisioterapie in pediatriese pasiënte met brongioliitis toepas. Bewyslewering vanuit hierdie studie kan fisioterapeute help met die keuse van effektiewe behandelingsprosedures.

Bronne

Die volgende databasisse is deursoek vir bewyse: African Health Line, CINAHL, Cochrane, Ebsco Host, Emerald Host, UP e-theses and dissertations, PEDro, Medline, Sabinet, Science Direct en Up To Date. Die soektog het 10,016 titels gelewer.

Metode

'n Sistematiese oorsig van die data is uitgevoer deur 'n gespesifiseerde soekstrategie, aangepas vir elke databasis, te volg. Sleutelwoorde was: "physiotherapy/physical therapy", "bronchiolitis" and "paediatric/pediatric" in kombinasie met "percussion", "postural drainage" and "suction". Voorafbepaalde insluitings- en uitsluitingskriteria is toegepas op titels, abstrakte en artikels soos toepaslik.

Data analise

Evalueringsinstrumente van die “National Health System Critical Appraisal Skills programme” (NHS CASP) asook die PEDro skaal (ewekansige gekontroleerde eksperiment) is gebruik vir evaluasie van en punttoedeling vir die verkose studies. Die punttoekenning is onafhanklik deur twee navorsers gedoen en konsensus is bereik deur onderhandeling. Die inligting verkry is gesintetiseer en gegradeer aan die hand van die Sackett hiërargie van bewyse. As gevolg van die heterogeniteit van die ingeslote studies en die aard van die resultate was ‘n meta-analise nie moontlik nie.

Resultate

Die studie het bevind dat daar geen bewyse is vir roetine borskasfisioterapie van ongekompliseerde akute virale pediatriese brongiolitis nie. Borskasfisioterapie verminder nie die duur van hospitaalverblyf, suurstofbehoefte of die kliniese respiratoriese aanduiding van stres in die pasiënte nie. In die geval van sekondêre bakteriële respiratoriese infeksies mag borskasfisioterapie egter geïndikeerd wees, afhangend van die evaluasie van elke individuele pasiënt.

Gevolgtrekking

Beklopping, posturale dreinasie, en suiging as roetine behandeling is nie effektief in die behandeling van brongiolitis in pasgebore tot 24 maand oue pasiënte nie, behalwe individuele gevalle met sekondêre bakteriële infeksies. In hierdie spesifieke subgroep moet borskasfisioterapie aangepas word vir pasiënt. Roetine fisioterapie is dus nie aangedui nie.

Implikasies

Borskasfisioterapie moet gebasseer wees op ‘n volledige evaluasie en kliniese meriete, asook bewyslewering en die pasiënt se voorkeure. Opleiding van fisioterapie studente by universiteite, asook dokters aangaande die huidige bewyslewering vir borskasfisioterapie in pediatriese brongiolitis is belangrik. Dokters en klinici moet bewus gemaak word dat roetine borskasfisioterapie vir pediatriese brongiolitis pasiënte *nie* voorgeskryf moet word nie.



Sleutelwoorde

Virale brongioliitis

Pulmonêre postural dreinasie

Respiratoriese brongioli

Respiratoriese dreinasie

Respiratoriese Sinsitium Virus infeksies

Respiratoriese terapie

Respiratoriese infeksies

Respiratoriese lugweg infeksies

Fisioterapie modaliteite

Fisioterapie tegnieke

Table of contents

DECLARATION	I
ACKNOWLEDGEMENTS.....	III
ABSTRACT	IV
OPSOMMING	VII
TABLE OF CONTENTS	X
LIST OF TABLES.....	XV
LIST OF FIGURES.....	XVI
APPENDICES.....	XVII
CHAPTER 1 INTRODUCTION AND BACKGROUND	1
1. BACKGROUND.....	1
2. PROBLEM STATEMENT	10
3. RESEARCH QUESTION AND AIM	10
4. OPERATIONAL DEFINITIONS.....	10
4.1 Bronchiolitis	10
4.2 Evidence-based practice	11
4.3 Evidence	11
4.4 Intervention.....	11
4.4.1 Percussion	12
4.4.2 Postural drainage	12
4.4.3 Suctioning.....	12
4.5 Paediatric patients	12
5. DISSERTATION OUTLINE.....	13

CHAPTER 2 LITERATURE REVIEW	14
1. Introduction	14
2. Respiratory therapy in paediatrics	14
3. Paediatric bronchiolitis	15
3.1 Epidemiology.....	15
3.2 Co-morbidities.....	16
3.3 Complications of bronchiolitis	17
3.3.1 Children with underlying pathologies	17
3.3.2 Asthma.....	17
3.3.3 HIV/AIDS.....	18
3.4 The economic cost	20
4. General medical management of bronchiolitis	21
4.1 Other treatment options for bronchiolitis	22
5. Chest physiotherapy FOR paediatric bronchiolitis	22
5.1 Percussion.....	23
5.2 Postural drainage	24
5.3 Suctioning	25
5.3.1 Suctioning in the paediatric population	25
5.4 Risks associated with chest physiotherapy treatment	28
CHAPTER 3 METHODOLOGY	31
1. Introduction	31
2. Research design	31
2.1 Systematic reviews defined	32
2.2 Advantages and disadvantages of a systematic review	32
3. Selecting data sources	34
4. Database search	35
4.1 Hand search	35
4.2 Snowballing	36
4.3 Keywords and MeSH terms	36
4.4 Pilot study	37



4.5 Eligibility criteria	38
4.5.1 Inclusion criteria	38
4.6 Process of data collection and extraction	39
5. Appraisal INSTRUMENTS.....	41
5.1 Instruments.....	42
5.1.1 Critical Appraisal Skills Programme (CASP).....	42
5.1.2 PEDro Scale	43
6. Validity	44
6.1 Construct validity:	44
6.2 Content validity	44
6.3 Face validity.....	45
7. Reliability	45
7.1 Inter-tester reliability	45
7.2 Intra-tester reliability	45
7.3 CASP	45
7.4 PEDro scale.....	46
8. Strategies to AVOID bias.....	47
8.1 Studies of high methodological quality	47
8.2 Number of raters.....	48
8.3 Publication bias.....	48
8.4 Selection and retrieval bias	49
8.5 Language bias.....	49
8.6 Multiple publication bias	49
8.7 Meta-analysis	50
9. Hierarchy of evidence	50
10. Ethical considerations	53
11. Summary	53
CHAPTER 4 RESULTS.....	54
1. Introduction	54
2. DESCRIPTION OF SAMPLE	54
2.1 Results of the search	54

2.2	Hand searching.....	61
2.3	Excluded studies.....	61
2.4	Included studies	63
3.	METHODOLOGICAL QUALITY	68
3.1	Introduction.....	68
3.2	Example of appraisal scores.....	68
3.3	Comparison of the two appraisal instruments used for RCTs	69
3.4	Summary of appraisal scores	70
4.	GRADING OF ARTICLES	71
5.	Summary	71
 CHAPTER 5 DISCUSSION, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION.....		 72
1.	Introduction	72
2.	SUMMARY OF FINDINGS	72
3.	Evaluation of the study.....	72
3.1	Relevance.....	72
3.2	Strengths.....	73
3.2.1	Methods.....	73
3.2.2	Inclusion of studies: All languages	74
3.2.3	Inclusion of studies: Studies with a variety of designs	74
3.2.4	Number of databases	75
3.3	Limitations.....	75
3.3.1	Validity and reliability	75
3.3.2	Limitations to the application in the South African setting	77
3.3.3	Family, caregivers and the wider community.....	78
3.3.4	Appraisal of this systematic review	78
3.3.5	Conclusion	79
3.4	Implications for clinical practice	79
3.5	Implications for the South African Society of Physiotherapy (SASP)	80
3.6	Clinicians, service managers and policy makers	80
3.7	Recommendations for education	81



4. Recommendations for future research.....	81
5. Conclusion.....	83
LIST OF REFERENCES	85

List of tables

Table 2.1: Recommended suction pressure for various age groups	27
Table 3.1: Summary of data collectors and reviewers	39
Table 3.2: Grading system according to Sackett et al. (2000)	52
Table 4.1: Included studies	64
Table 4.2: Characteristics of the included systematic reviews	65
Table 4.3: Characteristics of the included randomised controlled trial (1)	66
Table 4.4: Characteristics of the included randomised controlled trial (2)	67
Table 4.5: PEDro Scale (Randomised controlled trial) for Bohe et al. (2004).....	68
Table 4.6: CASP factors (Randomised controlled trial) for Bohe et al. (2004).....	69
Table 4.7: Comparison between CASP and PEDro	70
Table 4.8: Summary of appraisal scores.....	70

List of figures

Figure 2.1: Research process	33
Figure 3.1: Results for the Medline database	40
Figure 4.1a: Flow chart of data extraction	56
Figure 4.1b: Flow chart of data extraction	57
Figure 4.2: Flow of studies: the CINAHL database	57
Figure 4.3: Flow of studies: the COCHRANE database	58
Figure 4.4: Flow of studies: the Ebsco Host database	58
Figure 4.5: Flow of studies: the Medline database	59
Figure 4.6: Flow of studies: the PEDro database	59
Figure 4.7: Flow of studies: the Science Direct database	60
Figure 4.8: Flow of studies: the Up To Date database	60

Appendices

Refer to accompanying Compact Disc

APPENDIX A: Rationale for study.....	
APPENDIX B: Search protocol for databases.....	
APPENDIX C: Inclusion/Exclusion criteria	
APPENDIX D: Numbering sheet: template for study titles	
APPENDIX E: Data summary form	
APPENDIX F: Critical Appraisal Skills Programme (CASP).....	
APPENDIX G: PEDro Scale.....	
APPENDIX H: Titles contributed by each database.....	
APPENDIX I: Studies appraised: appraisal results	
List of databases.....	
Humour.....	
Abbreviations	
Flow diagrams of all databases.....	
Appraisal of the dissertation.....	
Full text articles	
Meta-analysis.....	
Up To Date: Research syntheses	

CHAPTER 1

Introduction and background

1. BACKGROUND

Infection of the airways is one of the most common causes of illness in children and results in high annual mortality, especially in children younger than five years of age (Smith & Ball, 1998, p. 263). Bronchiolitis is a lower airway infection, usually found in infants younger than two years of age, which causes an acute inflammatory response in the bronchioles to acute viral infection. The term “bronchiolitis” is used to refer to a syndrome and “symptom set” rather than to a specific disease process (or pathogen) (Willis, 2007). Illness that compromises the airway often causes an emergency, and this is especially so in paediatric patients because of their peculiar characteristics: a small subglottic space encircled by the cricoid cartilage and loosely attached connective tissue where oedema can easily accumulate. These anatomical features place paediatric patients at great risk of rapid respiratory deterioration (Kercsmar, 2003). The patient’s age increases the universal risk of an acute respiratory infection (ARI) and a poor outcome of the disease (Dakubo & Commey, 1996). Acute bronchiolitis is the leading cause of emergencies and hospitalisations during the winter months in children in the age group newborn to 24 months (Perotta, Ortiz & Roque, 2006; Piedra & Stark, 2009).

In the United Kingdom (UK), ten per cent of infants develop bronchiolitis each winter and 20 per cent of these are hospitalised. Despite the fact that only one to two per cent of Respiratory Syncytial Virus (RSV) patients are hospitalised, the monetary implications of RSV infection are relatively high (Steiner, 2004) and the peak incidence for hospitalisations is at two to six months of age. This is confirmed by statistics from the United States of America (USA) where bronchiolitis related to RSV is the leading cause of hospitalisations in infants younger than 12 months of age. RSV is the major causative pathogen (80%); para-influenza and adenoviruses are the other common causes of bronchiolitis (Couriel, 1999). The majority of RSV and bronchiolitis

hospitalisations occur in previously healthy infants (DeVincenzo, Aitken, & Harrison, 2004), and usually take on epidemic proportions during the winter months. Steiner (2004) found that the rate of serious bacterial infections concurrent with RSV infection in otherwise healthy infants was very low, less than two per cent (Steiner, 2004). In a recent study (Jeena et al., 2003, in Jeena, 2004) conducted amongst South African children with bronchiolitis the aetiology was mostly the result of RSV. The second most common cause was the para-influenza virus, but the adeno- and influenza viruses were rarely seen. The human metapneumovirus has also been identified as a significant cause of bronchiolitis (Jeena, 2004) and is a new pathogen that will also have to be reckoned with. The impact of bronchiolitis on the health care system is therefore fairly profound (Willis, 2007).

A preliminary literature search revealed little evidence to substantiate manual physiotherapy, its effects, contra-indications or the specific needs of paediatric patients in all pathologies, including bronchiolitis (Appendix A). Evidence for manual physiotherapy techniques was identified by the researcher, but this was mostly related to adult patients and their pathologies, and not to paediatric pathologies and diseases.

Research conducted in South Africa confirms the impact of respiratory diseases on the paediatric population. A recent report by the Department of Health (DOH) (2007) indicates that 40 per cent of all ambulatory paediatric patients, including those admitted to provincial hospitals, suffer from respiratory-related conditions. This high incidence of respiratory-related conditions is expected to rise. In the case of Human Immunodeficiency Virus (HIV)-infected children, the most common complaint is lung disease; and in children with Auto Immune Deficiency Syndrome (AIDS), lung pathology is the most common cause of mortality (DOH, 2007), especially in developing countries such as South Africa. Respiratory diseases such as bronchiolitis are prevalent in South Africa, and their impact is exacerbated by other infectious diseases such as HIV/AIDS. HIV/AIDS is currently the primary cause of

paediatric mortality: the statistical estimate of children dying under five years of age is 68 per 1000 live births (WHO, 2007).

Bronchiolitis hospitalisations have increased over the past twenty years, and many children suffering from bronchiolitis develop wheezing at a later stage in their lives (Psarras, Papadopoulos & Johnston 2004). RSV infection may follow the stages of acute infection, persistent wheezing and finally asthma. Wheezing is common in re-infections, and can persist for 11 years post bronchiolitis. The incidence of wheezing is highest in the first year post bronchiolitis and reduces with time. Up to 30 per cent of children with bronchiolitis will eventually develop asthma, compared to the three per cent of children with post upper respiratory infection who develop it (Jeena, 2004). Research provides strong evidence that the effect of bronchiolitis on the respiratory system is an increased incidence of reactive airway disease, atopy and asthma later in childhood (Lerou, 2001; Willis, 2007). Furthermore, long-term epidemiology studies have shown that the more severe the asthma in childhood, the more likely it is to continue in adulthood (Le Souef, 1999).

Limited progress has, however, been made in the medical as well as the physiotherapy management of paediatric patients with bronchiolitis. Therapy is sometimes controversial as it is often based on general recommendations and not necessarily on evidence-based strategies (Martín-Torres, 2001). Extrapolation of observations made on adults to the paediatric population is frequent, although not advisable, but it is often the only way to practise evidence-based medicine in paediatrics. A medical professional dealing mostly with paediatric patients knows: “Children are not miniature adults and airway disease in children differs from adult disease in both cause and clinical course” (Couriel, 1999). “An infant with pulmonary pathology cannot have the principles of adult management directly transposed to the paediatric setting” (Smith et al., 1998, p. 256). Clinicians are nonetheless unfortunately often forced to extrapolate care practices developed on adult patients owing to a lack of evidence from paediatric and neonate patients.

This lack of evidence emphasises the fact that although management of neonates and paediatric patients has improved over the past years, much research still needs to be done. The fact that more studies have been done on adults suffering respiratory failure and requiring mechanical ventilation, than on infants and children (Kerscmar, 2003) confirms this dearth of evidence. In South Africa, a review by the Cardiopulmonary Rehabilitation Special Interest Group of the South African Society of Physiotherapy (SASP) of evidence in cardiopulmonary physiotherapy described some evidence for physiotherapy services in the field of respiratory conditions, but focused mainly on the treatment of adults and neglected interventions for children (SASP, 2006). Furthermore, this researcher has observed that most articles published on respiratory paediatric conditions focus on interventions of *ventilated* paediatric patients.

At this point, research into paediatric bronchiolitis has found that treatment is mostly supportive, using humidified oxygen therapy, fluid management (hydration) (Webb & Reynolds, 1996), avoidance of unnecessary handling, respiratory support where necessary (Barben, Kuehni, Trachsel, & Hammer, 2008; Couriel, 1999; Jeena, 2004; Lerou, 2001; Willis, 2007) and nasal suctioning if indicated (Kerscmar, 2003). Systematic reviews suggest that pharmacological therapies such as B₂ agonists, epinephrine, anticholinergics as well as systemic and inhaled corticosteroids do not shorten the natural course of the disease or provide clinically relevant improvements, and should therefore not be routinely used (Barben et al., 2008; Willis, 2007). Little evidence exists for the use of pharmacological therapies, or for techniques such as airway clearance, in the management of paediatric patients with acute respiratory pathologies (De Boeck, Vermeulen, Vreys, Moens & Proesmans, 2008). The widespread use of these therapies is, despite distinct evidence of their disadvantages, still very prominent in the clinical scenario in Europe and Canada (Barben et al., 2008). The researcher also observed that in various South African hospitals and private practice settings these therapies are commonly used in the paediatric setting without strong evidence of their effectiveness.

Owing to a lack of evidence supporting pharmacological treatment and other interventions, the Swiss Association of Paediatric Pulmonology discourages the use of pharmaceuticals as well as chest physiotherapy in previously healthy infants with bronchiolitis (Barben et al., 2008). Other authors confirm the Association's position: chest physiotherapy does not produce clinically important benefits in the treatment of acute bronchiolitis (Bohe, Ferrero, Cuestas, Polliotto & Genoff, 2004) without secondary bacterial infections or other pathologies (Nicholas, Dhouieb, Marshall, Edmunds & Grant, 1999).

In addition to a lack of evidence of proven benefits of chest physiotherapy, these techniques also entail significant handling of the patient and can therefore cause acute deterioration (Webb et al., 1996) in patients with bronchiolitis. A survey conducted in Switzerland in 2001 concluded that almost all paediatricians prescribed bronchodilators and inhaled corticosteroids for both in- and out-patients with bronchiolitis (Barben et al., 2008). The need was therefore recognised for the implementation of national guidelines for the management of bronchiolitis and virus induced wheeze (Barben et al., 2008). According to Barben et al. (2008), this was the first study to demonstrate a clinically relevant change in the management of acute bronchiolitis by paediatricians after the implementation of a national guideline. These guidelines discourage the use of pharmaceuticals as well as physiotherapy in previously healthy infants with bronchiolitis. The significance of this finding for physiotherapists is the fact that, post implementation of these guidelines, the percentage of physiotherapy referrals decreased from 42 per cent in 2001 to 14 per cent in 2006 (Barben et al., 2008).

The Scottish Intercollegiate Guidelines Network (SIGN) (2006) determined that chest physiotherapy using vibration and percussion is not recommended for the treatment of acute bronchiolitis if the patient is not admitted to an Intensive Care Unit (ICU) (SIGN, 2006). Until recently, the combination of postural drainage and percussion was prescribed by doctors or clinicians, as it was viewed that these techniques could do no harm, even if they were not

effective. However, recent research has shown that the combination of postural drainage and percussion might have a detrimental effect on patients (McIlwaine, 2006).

A systematic review by Perotta et al. (2006) concluded that chest physiotherapy using percussion and vibration techniques does not reduce the length of hospital stay, oxygen requirements, or improve the clinical severity score in non-ventilated infants with acute bronchiolitis without co-morbidities (Perotta et al., 2006). Panickar and Eisenhut (2008) confirm this. On the other hand, SIGN revealed that nasal suctioning is effective in clearing secretions in hospitalised bronchiolitis infants if respiratory distress is due to nasal blockage (Baumer, 2007; Panickar & Eisenhut, 2008).

This leads to the question: what evidence exists in paediatric pulmonology regarding the effectiveness of physiotherapy interventions? It was observed that many articles on paediatric pulmonology have been published in the field of asthma, bronchopulmonary dysplasia (BPD) and cystic fibrosis (CF). However, most of the articles dealing with respiratory ailments referred to *ventilated* paediatric patients.

Although regular chest physiotherapy plays a role in reducing the morbidity in children with chronic lung diseases such as CF (Balachandran, Shivbalan, & Thangavelu, 2005), it has failed to show benefits for patients with pneumonia and acute bronchiolitis but without secondary respiratory or sinus infections. Therefore chest physiotherapy is *not* mentioned as a treatment in the major American paediatric textbooks, and is considered rather as *not being recommended* (Chalumeau et al., 2002). On the other hand, chest physiotherapy “can be indicated” in cases of bronchial secretions in the paediatric patient with bronchiolitis (Deschildre et al., 2000). However, treatments including chest physiotherapy for paediatric bronchiolitis require further randomised controlled trials to justify their use (Martín-Torres et al., 2001). The world over, paediatrics seem to be a neglected area in the

physiotherapy discipline (Moseley, Herbert, Sherrington & Maher 2002). Subsequently, there is a limited evidence base.

The number of systematic reviews and guidelines has stayed modest, compared to the improvement and growth in randomised controlled trials over the past years. However, the disturbing truth is that paediatric studies, defined as those with a study sample of under 16 years of age, received much more attention in the 1970s, when ranked according to output, than in the new millennium (Maher, Moseley, Sherrington, Elkins, & Herbert, 2008). The largest number of trials (39%) and reviews (36%) were conducted in the area of musculoskeletal physiotherapy. Evidence for neurological physiotherapy ranked fourth and ergonomics and paediatrics comprised the smallest number of trials and reviews (Moseley et al., 2002). The researcher also observed that in the field of paediatrics, current articles are dominated by cerebral palsy (CP) and asthma. This observation is confirmed by Maher et al. (2008) who note that there has been a relative decrease in paediatric research in recent years. Paediatrics as a sub-discipline was ranked third in the 1970s in terms of output, but has fallen to seventh place at the present time (Maher et al., 2008).

Furthermore, no integrated evidence-based treatment model on chest physiotherapy for paediatric patients with bronchiolitis could be found. Although a study on neonates was conducted in Neonatal Intensive Care Units (NICU) in Australia (Hudson & Box, 2003) in order to determine whether physiotherapists applied evidence in their clinical practice, no similar study could be found in the South African context.

However, a few clinical practice guidelines have been published since the proposal for this study was developed. These guidelines include the "Diagnosis and Management of Bronchiolitis" published (2006) by the American Academy of Pediatrics, the Cincinnati Children's Hospital's Medical Centre's "Management of bronchiolitis in infants less than one year" (2005), and the SIGN "National clinical guideline" (2006). These guidelines provide

accounts of general medical management with only minimal referral to chest physiotherapy. It is therefore hoped that the present study will add to the body

of knowledge and the number of reviews of paediatric physiotherapy (AAP, 2006; Cincinnati Children's Hospital Medical Center, 2005; SIGN, 2006).

Most randomised controlled trials, systematic reviews and clinical practice guidelines in physiotherapy (physical therapy) indexed in the Physiotherapy Evidence Database (PEDro) have occurred since 2000 (Maher et al., 2008). An exponential increase in randomised controlled trials in the PEDro list of studies, as well as an improvement in their methodological quality, has taken place over the 40 years from 1960 to 2000. This increase in new findings has made it essential to conduct *systematic reviews* in order to synthesise and summarise the rapidly growing information database and minimise the amount of reading required of the practitioner (Maher et al., 2008). Systematic reviews are very efficient in assisting practitioners in time management. In the words of Mulrow (1987): "Systematic reviews are concise summaries of the best available evidence that address sharply defined clinical questions" (Mulrow, 1987).

A systematic review would thus be useful in determining the latest evidence and how this should be applied effectively in the clinical setting to eliminate the discrepancies between evidence-based literature and clinical practice. A review of relevant literature and sources pertinent to providing in-depth knowledge would generate a picture of what is known about a particular situation and the knowledge gaps that exist (Burns & Grove, 2005).

Properly conducted trials, as a robust form of evidence, are rare and physiotherapists tend to draw instead on other types of evidence, such as clinical experience, biological rationale and the results of explicit tests determining the effects of intervention (Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999).

Many of the treatment interventions physiotherapists make in a practical setting await definite research to establish their efficacy. Physiotherapists are ethically bound to provide patients with the best possible treatment. From a political as well as an economical point of view physiotherapists must be able to prove that their services are worth paying for (Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999). Evidence-based practice is thus essential and treatment such as chest physiotherapy requires further randomised controlled studies in order that clinical practice reflects evidence-based measures. This notion has been dubbed “evidence-based purchasing” (Long & Harris, 1996, in Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999). Evidence-based and credible practice is essential for the survival of physiotherapy as a profession. But convincing evidence of the effectiveness of treatments can only be produced from properly conducted research (Sackett et al., 1998, in Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999).

The challenges that face physiotherapy research are many and include financial burdens and limited resources (Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999).

Despite these various challenges, physiotherapists have an obligation to determine the best evidence for the treatment of their patients.

Physiotherapists employ techniques that are not used by other health care professionals; the physiotherapist’s perspective should thus be applied in the interpretation of available evidence. Physiotherapists need to join forces with those health care providers who are evaluating the efficacy of their treatments. If not, they run the risk of their own perspective being ignored by clinicians, associations and medical fund providers who have other priorities (Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999).

2. PROBLEM STATEMENT

The only systematic review regarding physiotherapy in paediatric bronchiolitis found, by the researcher was a review done by Perotta et al. (2006). This study has methodological limitations. One shortcoming is the fact that the researchers made use of only four databases and included only three randomised controlled trials. The question arises: should published guidelines on paediatric bronchiolitis and other articles on the subject base their findings regarding chest physiotherapy on only one systematic review? In an attempt to answer this question, this study aims to bridge the knowledge “gap” and conduct a thorough investigation of chest physiotherapy in paediatric patients with bronchiolitis by examining the literature.

3. RESEARCH QUESTION AND AIM

The core research question guiding this study is:

What current evidence exists to support the use of chest manual physiotherapy in non-ventilated patients with bronchiolitis, in the group newborn to 24 months of age?

The primary aim of this study is to improve chest physiotherapy intervention of the paediatric population group (0 to 24 months) suffering with bronchiolitis.

4. OPERATIONAL DEFINITIONS

4.1 Bronchiolitis

This review deals with bronchiolitis excluding the following types :

- a) bronchiolitis organising pneumonia as this is categorised as pneumonia,
- b) bronchiolitis obliterans also known as obliterative bronchiolitis or constrictive bronchiolitis, and
- c) follicular bronchiolitis.

4.2 Evidence-based practice

Evidence-based practice is clinical-setting practice based on current best evidence, professional expertise and experience guiding clinical decision making within context (Hek, Judd & Moule, 2002, p. 135; Sackett et al., 1996, in Campbell, van der Linden & Palisano, 2006, p. 4) and taking into account the personal preference, values and needs of every individual patient (Research Committee (Victorian Branch) of the Australian Physiotherapy Association and contributors, 1999).

4.3 Evidence

In this study, evidence was searched from a variety of sources: randomised controlled trials, cohort studies, case control studies, reviews (narrative and systematic) and qualitative research into the effects of treatment.

4.4 Intervention

In this study, intervention refers to active and non-active physiotherapy techniques generally used in the clinical setting for the management of

respiratory conditions, known as chest physiotherapy. In this instance, intervention is limited to the techniques of percussion, postural drainage and suctioning.

4.4.1 Percussion

Percussion, also known as “cupping”, is the rhythmical striking of the chest wall over the affected lung segments, using cupped hands and a flexion and extension movement of relaxed wrists. This can be performed single or double handed (Pryor & Prasad, 2002, p. 199). Percussion begins gently and increases in force as the patient tolerates increased percussion (Anderson, Keith, Novak & Elliot, 2002).

4.4.2 Postural drainage

Postural drainage is the use of positional change and gravity to assist in the movement and drainage of secretions from the affected area(s) of the lung into the trachea. Postural drainage is often combined with interventions such as chest percussion, vibration, nebulisation and coughing to expel secretions from the trachea (Anderson, et al., 2002).

4.4.3 Suctioning

Suctioning is a method used to remove secretions or foreign material from the airways, pharynx and nasal passages where patients are unable to effectively remove the secretions themselves (Pretorius, Catzel, Cronje, Findlay, & van Heerden, 1981, p. 25; Taeusch, Christiansen & Buescher, 1996, p. 72).

4.5 Paediatric patients

Paediatric patients in this study refers to patients two years of age or younger, as bronchiolitis is usually found in the age group newborn to 24 months (Anderson et al., 2002).

5. DISSERTATION OUTLINE

The dissertation comprises the following:

Chapter 1: Introduction.

Chapter 2: A comprehensive literature review.

Chapter 3: Methodology.

Chapter 4: The discussion of the results.

Chapter 5: The discussion, limitations, recommendations and conclusion.

CHAPTER 2

Literature review

1. INTRODUCTION

In this chapter the epidemiology, co-morbidities, complications and use of chest physiotherapy in the treatment of paediatric bronchiolitis will be discussed.

2. RESPIRATORY THERAPY IN PAEDIATRICS

Respiratory therapy is the treatment administered to preserve, maintain and promote optimal pulmonary function by managing acute and chronic breathing disorders to improve the ventilation function of the pulmonary system or respiratory tract (Opdekamp & Sergysels, 2003; TheFreeDictionary, n.d.). Chest physiotherapy forms an integral part of respiratory therapy.

Chest physiotherapy comprises a group of treatments that aims to achieve optimal respiratory functions, and includes strengthening and endurance exercises for respiratory muscles, suctioning to clear secretions from the airway, the use of aerosol mists (bronchodilators and saline) or gases, postural drainage, turning, percussion, vibrations and cough stimulation (Mitra, 2007; Answers.com, n.d.).

Chest physiotherapy is seen as an important adjunct in the treatment of respiratory conditions (Balachandran et al., 2005). It can be applied to neonates, infants, children as well as adults (Smith et al., 1998; TheFreeDictionary, n.d.).

3. PAEDIATRIC BRONCHIOLITIS

In bronchiolitis the virus invades the bronchiolar epithelium causing destruction of cilia and necrosis of epithelial cells which in turn cause increased secretions, mucus plugging and cellular debris (Polak, 2004; Welliver, 2004). Airway obstruction can be aggravated by submucosal edema caused by the inflammatory reaction (Polak, 2004; Smyth & Openshaw, 2006). This inflammation leads to areas of hyperinflation and of atelectasis which bring about a mismatch in ventilation/perfusion of the lungs, hypoxia, hypercapnia and increased effort in breathing (Webb et al., 1996).

Only a third of the infected population will develop a lower respiratory infection like bronchiolitis with the associated mucus plugging, bronchospasm and airway inflammation (Zorc & Phelan, 2008). Clinically, bronchiolitis presents with a two- to three day upper-respiratory prodrome leading to increased respiratory difficulty which manifests in chest hyperinflation, widespread fine crepitations, retractions and often, but not always, audible wheezing and scattered rhonchi on auscultation (Polak, 2004; Smyth et al., 2006; Tercier, 1983; Webb et al., 1996). This term is consequently used more to refer to a specific syndrome and “symptom set” and is regarded as a clinical diagnosis (Mansbach & Camargo, 2009; Smyth et al., 2006) rather than a specific disease process or pathogen (Willis, 2007).

3.1 Epidemiology

Approximately two per cent of all infants will be hospitalised annually for RSV infection, and the hospitalisation rate seems to be increasing (Welliver, 2004). Hospital admission rates for bronchiolitis vary but are well documented for the paediatric population in the USA and in European countries: 30 per 1000 for children younger than 12 months (Smyth et al., 2006). RSV accounts for 50 per cent of admissions (Jeena, 2004). More than 90 000 infants are hospitalised with RSV infection annually in the USA (Park & Barnett, 2002). Polak (2004) mentions that RSV infections cause more than 100 000

hospitalisations per annum (Polak, 2004) and Sorce (2009) reports 125 000 hospitalisations per year (Sorce, 2009).

RSV contributes directly or indirectly to the deaths of about 600 000 to 1 000 000 infants and children per annum worldwide. In the United States, hundreds of infants will die annually as a direct result of the RSV infection and additional thousands will die from complications (Polak, 2004). On the other hand, it has been reported by other authors that deaths due directly to bronchiolitis are lower than estimated (Zorc et al., 2008), only about three per cent (Kercsmar, 2003).

RSV epidemics occur mostly during the winter months (Bar-on & Zanga, 1996; Fischer, Teper & Colom, 2002; Jeena, 2004). In Gauteng and the Western Cape, however, there are dual epidemics from March to April and then again from July to August. In areas where HIV is widespread, the most common seasons for bronchiolitis are less clear due to the continual shedding of the RSV in patients living with HIV (Jeena, 2004).

3.2 Co-morbidities

Co-morbidities such as secondary bacterial infections are rarely seen in conjunction with bronchiolitis, but they may co-exist (Jeena, 2004). The rate of serious bacterial infections like pneumonia concurrent with RSV infection in otherwise healthy infants is low (less than two per cent). Otitis media and urinary tract infection (UTIs), on the other hand, are more common co-morbidities found in bronchiolitis (Dayan, Roskind, Levine & Kupperman, 2004; Steiner, 2004) and do not indicate chest physiotherapy as pneumonia or sinusitis would.

The literature does seem to be contradictory, however: the incidence of bacterial pneumonia is higher in children with RSV (18% to 44%) than in children without RSV infection (Sorce, 1999), while bacterial illness in children with bronchiolitis might be lower than in those without bronchiolitis

(Dayan et al., 2004). It seems that there is no consensus regarding bacterial co-morbidities in paediatric patients with bronchiolitis.

3.3 Complications of bronchiolitis

3.3.1 Children with underlying pathologies

Children with underlying pathologies and co-morbidities such as lung transplants, pulmonary disease or congenital lung or heart disorders and immunological disorders are at higher risk of developing bronchiolitis (Willis, 2007) and complications which might lead to death. Although the fatality rate of patients with pulmonary and cardiac disease has been reduced to between three and four per cent with improved early recognition and treatment, morbidity from this disease remains high (Rodriquez et al., 1997).

3.3.2 Asthma

There is evidence to suggest long-term negative effects on pulmonary functioning from lower respiratory tract infections. Early childhood lower respiratory tract infections are associated with wheezing and subsequent asthma. This link is, however, caused by multifactorial pathophysiological pathways (Lerou, 2001).

Admission to hospital due to acute viral bronchiolitis has been associated with recurrent respiratory problems during early childhood and an increased risk of asthma (Calogero, 2007).

Asthma can be defined as a chronic inflammatory pulmonary disorder characterised by reversible obstruction of the airways (MerckMedicus, n.d.). Since the 1980s, there has been an increase worldwide in the prevalence of asthma in both children and adults. This escalation has led to significant increases in morbidity and mortality.

Most children recover from bronchiolitis within seven to ten days, but a subset of patients has a recurrent wheeze and cough for months or even years (Couriel, 1999). Multiple studies indicate that children diagnosed with bronchiolitis are at a significantly higher risk of developing future reactive airway disease, wheezing and asthma (Couriel, 1999; Evans, Kramer & Kravitz, 1998; Smyth et al., 2006), and the risk of developing these diseases can last until the teenage years (Willis, 2007). Long-term epidemiological studies have shown that the more severe the asthma in childhood, the more likely it is to continue into adulthood (Le Souef, 1999). However, there is no consensus between various studies on the percentage of patients with bronchiolitis who will develop wheezing and asthma later in life.

Recent studies have also found a major link between rhinovirus (RV), lower respiratory tract infection and wheezing in the first year of life (Calogero et al., 2007). Lemanske et al. (2005) and Kugel et al. (2006) found that RV was responsible for about three times as many lower respiratory tract infections (LRTI) with wheezing compared to RSV in the first year of life. The patients in these studies were observed up to the age of five and LRTI accompanied by a wheeze in the first year of life was a major risk factor for asthma at the age of five years. This raises doubts about RSV and its significant role in inducing asthma and supports instead the theory of a “favourable host” (Lemanske et al., 2005 & Kugel et al., 2006, in Calogero et al., 2007).

3.3.3 HIV/AIDS

South Africa has a complex paediatric patient population as a result of the influence and high prevalence of HIV/AIDS. The HIV pandemic has given rise to a growing population of paediatric patients who are at high risk for infectious diseases, especially in the developing world where about 95 per cent of HIV-infected children are found (including South Africa). Since the first cases of AIDS were diagnosed in 1981, more than 22 million people (including about five million paediatric patients) have died of AIDS-related illnesses. Opportunistic infections are critical indicators of disease progression as well

as a major cause of morbidity and, in developing countries, of potential mortality (Sing & Govender, 2009). This was confirmed by Dashefsky (1999) who stated that children affected by HIV/AIDS are significantly more affected by pulmonary infections and other complications. This trend has been apparent since the 1980s. At a time (1982 to 1988) when antiretroviral treatment was not widely used, pulmonary disease was the original manifestation of the HIV infection in 52 per cent of paediatric subjects. The most common infections in these paediatric patients were, in order of importance/relevance, pneumocystic carinii pneumonia (PCP), bacterial pneumonia, and pulmonary lymphoid hyperplasia/lymphoid interstitial pneumonitis (PLH/LIP). Two thirds (68%) of the patients in this study died within two years of the onset of the pulmonary disease, and in 50 per cent of the subjects the primary cause of death was pulmonary complications. Pulmonary infections in these paediatric patients varied from a mild self-limiting disease to severe disease that could culminate in death (Dashefsky, 1999).

Various other reports have discussed the link between pulmonary infections and children living with HIV, and the fact that respiratory infections are the leading cause of morbidity and mortality. Opportunistic pulmonary infections represent about 65 per cent of all AIDS defining illnesses, and more than 70 per cent of patients living with AIDS will suffer from a respiratory illness during the course of their lifetime (Maki, 2000). Most life-threatening infections suffered by these patients find their way into the body via the respiratory system. Pulmonary complications of HIV will probably continue to cause frequent and complex problems for paediatric patients living with HIV as well as the clinicians who work with them, including physiotherapists (Dashefsky, 1999).

Despite advances in technology including Highly Active Anti-Retroviral Treatment (HAART), medical care, treatment and prevention of HIV and opportunistic infections, particularly in developing countries, the pandemic still continues almost unabated (Sing et al., 2009). It is thus of utmost importance

to understand that HIV/AIDS will have an influence on the paediatric bronchiolitis population of South Africa because RSV and para-influenza virus infections are amongst the most commonly found in HIV-infected paediatric patients (Dashefsky, 1999). Furthermore, it must be kept in mind that children with AIDS shed RSV for longer periods, and appropriate precautionary measures should be taken to prevent respiratory infections, specifically bronchiolitis (Fischer et al., 2002).

3.4 The economic cost

If asthma is the most common chronic disease in childhood, then bronchiolitis and RSV infections are the most common serious acute illnesses in infants and young children (Kercsmar, 2003). Viral bronchiolitis is associated with considerable acute morbidity and mortality, and this places economic and social burdens on the community. Those children with bronchiolitis and RSV infections who are under two years of age are at greatest risk of developing serious respiratory illnesses. Almost 90 per cent of children are infected with RSV during the first two years of life, and while most of these patients are limited to a “cold prodrome” and can be treated at home, in some patients the symptoms might be more severe and require hospitalisation. One to three per cent of infants infected with RSV require hospitalisation (Kercsmar, 2003).

Paediatric patients with bronchiolitis who receive oxygen in the Emergency Department (ED) and Emergency Department Observation Unit (EDOU) as well as deep suctioning and intravenous (IV) fluids are more likely to be admitted to hospital. Patients experiencing bronchiolitis with a prolonged duration of symptoms and hypoxia in the ED are also more likely to be admitted to hospital (Shabana, Long Ma & Aderonke, 2008).

Acute viral bronchiolitis is the most frequent cause of hospital admissions in previously well infants in developed countries. The hospitalisation rate has increased over the past years, particularly between 1988 and 1996 (Park et al., 2002), but has doubled in recent decades (Zorc et al., 2008). Bronchiolitis is the leading cause of hospitalisation of infants in the USA, and the associated costs are more than 500 million dollars per annum (Mansbach et al., 2009), just for hospitalised infants with RSV infections the cost is about 300 million dollars per annum (Park et al., 2002). In 2001, the cost of acute viral bronchiolitis hospitalisation in children under 12 months of age was estimated as greater than 700 million dollars per annum in the United States (Calogero, 2007).

Unfortunately, no data is available for developing countries, although infants living in social deprivation as is the case in many rural areas in South Africa have a higher risk of hospital admission (Fischer et al., 2002).

Morbidity in the paediatric population is high and the possible association with asthma leads to preventative measures being taken, which has a further cost implication. Most of the costs however stem from outpatient care during a bronchiolitis epidemic (Sannier et al., 2001). Acute viral bronchiolitis remains a cause of significant morbidity as well as health care costs in young infants (Wainwright, 2010) therefore new treatment techniques and prophylaxis/prevention of RSV could have an impact by reducing these burdens (Jeena, 2004).

4. GENERAL MEDICAL MANAGEMENT OF BRONCHIOLITIS

Medical assistance of previously healthy infants with acute viral bronchiolitis includes monitoring the clinical status, maintaining adequate hydration and oxygenation, maintaining an open and clear airway and the option of parental education. This also forms the basis of the treatment of RSV infections. The majority of infants and older children with RSV bronchiolitis have mild symptoms and do not require *any* therapeutic intervention. Treatment of bronchiolitis is focused on correcting hypoxia, reversing bronchospasm,

treating airway inflammation and, if possible, treating the causative agent. Treatment of paediatric patients with bronchiolitis is mostly supportive (Smyth et al., 2006) and consists mainly of adequate hydration, supplemental oxygen (Fischer et al., 2002; Steiner, 2004; Tercier, 1983), nasal suctioning, and in some cases administration of a nebulised bronchodilator (Barben et al., 2008; Kercsmar, 2003; Wainwright, 2010), nasogastric tube feeding (Fazakerley, 2004), avoidance of unnecessary handling and “overtreating” of the patient (Barben et al., 2008) and mechanical ventilation if indicated (Krilov, 2010).

4.1 Other treatment options for bronchiolitis

Other treatment techniques that are commonly used in paediatric bronchiolitis include heliox therapy, nasogastric rehydration, antibiotics, montelukast, ribavirin, corticosteroids (systemic and inhaled), bronchodilators, palivizumab and forced expiratory manoeuvres such as the Increase of Expiratory Flow technique (IEF) (Kercsmar, 2003; Marechal, Barthod, Lottin, Gautier, & Jeulin, 2007). Unfortunately, most of these techniques are based on poor or no evidence whatsoever. In the words of Kercsmar (2003): “Currently there is no cure (for bronchiolitis), no effective preventative measure, no vaccine, no effective treatments and no consensus in how to apply supportive care” (Kercsmar, 2003).

5. CHEST PHYSIOTHERAPY FOR PAEDIATRIC BRONCHIOLITIS

Over the past few years the term chest physiotherapy has become more comprehensive, including airway clearance techniques, exercise, positioning, re-education of breathing, thoracic mobility exercises as well as nebulisation. Various airway clearance techniques exist for use by physiotherapists although not all of them have validated data to support their application in the clinical setting.

It is recommended that chest physiotherapy be administered one to four times a day, preferably 30 minutes before a meal, or alternatively 90 minutes after a meal. The total duration of treatment should not exceed 30 minutes, with three to six minutes in each position (Balachandran, 2005).

Although chest physiotherapy consists of various techniques, not all of these are suitable for the age group newborn to 24 months. Percussion, postural drainage and suctioning are the techniques most commonly used with this group of patients.

5.1 Percussion

With percussion the aim is to enhance mucociliary clearance from central and peripheral airways because mucociliary flow is dependent on the visco-elastic property of the mucus, the geometry of the airway and the speed of the airflow. Alterations in the airway diameter and flow may decrease the viscosity of mucus, making percussion more effective in mobilising secretions that are adhering to the bronchial walls (Ciesla, 1996). Once the secretions have been removed by coughing or suctioning, breathing sounds improve.

One important guideline is that percussion should be administered at the rate of three strikes per second over the part of the bronchopulmonary segment that requires drainage (Balachandran et al., 2005). The optimal frequency and force of chest percussion are unknown. Frequencies of 100 to 480 cycles per minute, producing 2.7 to 5.4 Nm and 58 to 65 N of force on the chest wall have been reported (Ciesla, 1996). If percussions are done properly they are effective in dislodging secretions instead of causing discomfort (Balachandran et al., 2005).

Percussion and vibration are techniques most commonly used on *intubated* and *mechanically ventilated* patients, as well as those with impaired cognition or the inability to cough. Chest percussion is often combined with postural drainage and vibrations in order to enhance mucus clearance even more (Smith et al., 1998). The latter techniques are, however, also used on non-ventilated paediatric patients.

5.2 Postural drainage

Postural drainage prevents the accumulation and enhances the movement of bronchial secretions from the peripheral to central airway by using gravitational force (Balachandran et al., 2005; Ciesla, 1996; Frownfelter, 1987 p. 271). The time required for effective drainage of an area is at least three to five minutes, but if the position is not well tolerated this will have to be shortened (Frownfelter, 1987 p. 689). Postural drainage causes fatigue; therefore the most affected areas should be treated first, followed by those areas which are less involved (Frownfelter, 1987, p. 689).

In Canada, the use of postural drainage and percussion has changed: the head-down position is no longer used as frequently. Instead, patients are placed in positions that optimise ventilation to specific lung areas. Speculation exists as to whether redistribution of ventilation alters local airway patency (McIlwaine, 2006).

Chest physiotherapy usually utilises three techniques in conjunction with postural drainage, because mere tilting of the thorax is not effective on its own. If complemented by breathing exercises, percussion, vibration and coughing, secretions will be dislodged. The patient is placed in the postural drainage position and the adjunct techniques are then performed in order to loosen secretions mechanically, to improve ventilation distribution and to assist in the movement of secretions cephalad (Balachandran et al., 2005; Frownfelter, 1987, p. 288). In the population newborn to 24 months, breathing

exercises are not applicable and vibrations not always effective owing to these children's alveoli closing volume.

Non-specific positioning, although not recently reported, seems to be used by the majority of therapists. This could be linked to the current trend in adult and paediatric respiratory therapy regarding non-specific turning (modified postural training) as explained by Parker et al. (1998) as well as the use of percussion and vibrations in non-tipped positions (McIlwaine, 2006; Parker et al., in Hudson et al., 2003).

5.3 Suctioning

Nasotracheal suctioning is intended to remove accumulated saliva, pulmonary secretions (excessive secretions, to be suctioned two to three hourly), blood, vomitus and other foreign material from the airways (trachea and nasopharyngeal) that cannot be removed by the patient's (adult or paediatric) spontaneous coughing or other less invasive procedures (AAP, 2006; Frownfelter, 1987; McIlwaine, 1996; Smith et al., 1998). Suctioning is thus used to maintain a patient's airways, ensuring adequate oxygenation and ventilation and avoiding intubation (AARC, 2004). Removal of such secretions also reduces the risk of atelectasis (Prasad & Hussey, 1995). Airway suctioning frequently improves breath sounds and may even lower airway pressures (Ciesla, 1996).

5.3.1 Suctioning in the paediatric population

Airway suctioning is a common procedure in the treatment of paediatric patients with a variety of pathologies: 82 per cent of physicians recommend nasal suctioning (Wainwright, 2010). It is most frequently undertaken to remove excessive or retained secretions from a child's respiratory tract, especially if effective clearance of secretions cannot be achieved by children younger than two (Smith et al., 1998). It may be performed as a single procedure by nursing and medical staff (or occasionally by parents), or it may

be incorporated into a chest physiotherapy regime. Nasotracheal suctioning should be performed by a skilled caregiver only when indicated and other secretion removal methods have failed (AARC, 2004). The removal of mucus and debris by deep nasopharyngeal suctioning has been shown to improve respiratory status in hospitalised infants with bronchiolitis (Polak, 2004).

In small infants and children a bulb sucker can also be used to clear oral and nasal secretions (Sorce, 2009). According to the Scottish Intercollegiate Guideline Network (SIGN), nasal suctioning should be used only in infants who exhibit respiratory distress owing to nasal discharge (SIGN, 2006).

The type and size of catheter used influences the degree of trauma caused to the mucosal wall (Ciesla, 1996):

- The more eyes the catheter has, the fewer traumas are caused
- Side holes: two or more will help minimise tracheal mucosal damage and optimise secretion removal
- Polyvinylchloride is the best material for suction catheters
- The tip design should be straight for routine use

It is suggested that the depth of suctioning should be to the point where it stimulates a cough; in most cases, upper airway suctioning is successful.

Suction should be performed for no more than five seconds with each catheter withdrawal (Frownfelter, 1987, p. 690).

As far as suction pressure is concerned, the maximum used on a child should be 200 mmHg, and the optimum pressure for a neonate is 100 to 150 mmHg. A negative pressure of too high a value has been shown to cause trauma, hypoxemia and atelectasis (AARC, 2004) and caution must be used when applying suctioning as a treatment technique.

Table 2.1 Recommended suction pressure for various age groups

Age group	Recommended suction pressure
Neonates	60-80 mmHg # Size 5/6 French (neonate and premature)
Infants	80-100mmHg * 60-90 mmHg # Size 6/8 French commonly used
Children	100-120mmHg * 90-110 mmHg # Size 6/8 French commonly used
Older children	* 110-150mmHg # Size 10 French

AARC clinical practice guideline, 2004

* MacMillan, 1995

Ciesla, 1996

A general guideline is that the suction catheter's size should be one half of the diameter of the airway (Ciesla, 1996).

When considering suction pressures, the literature is contradictory, and this leaves room for variation. Suctioning techniques and knowledge regarding suctioning also vary considerably amongst health care professionals, especially nurses and physiotherapists (Macmillan, 1995). Suctioning is not a benign procedure and adverse physiological effects directly attributed to airway suction are well documented. These effects can be both immediate and long-term, and therefore a sound knowledge of the procedure and its effects are a prerequisite for its undertaking, as is the availability of full resuscitation facilities (NHS, 2009).

Suctioning can cause hypoxia and it is advisable to have a transcutaneous oxygen monitor available (Frownfelter, 1987, p. 690), as well as oxygen. It is also advisable to pre-oxygenate. Complications that may occur as a result of suctioning are serious and include infection, hypoxaemia, trauma to the trachea, hypertension or arrhythmias, increased intracranial pressure, anxiety, laryngospasm and bleeding (Ciesla, 1996). It must therefore be kept in mind that children should not receive physiotherapy routinely, as this is not always beneficial. However, suctioning of the oropharynx and the nasopharynx may be helpful in the acute phase of the illness (Hodge & Chetcuti, 2000).

5.4 Risks associated with chest physiotherapy treatment

Webb and Reynolds (1996) concluded that the only treatment method with proven benefit and that can be used for routine management of paediatric patients with bronchiolitis is oxygen therapy and maintenance of fluid (Webb et al., 1996). Chest physiotherapy is regarded as having no role in the treatment at all: not only is there no proven benefit, but it entails significant handling and can cause acute deterioration in the patient's condition (Chalumeau, 2002; Webb et al., 1996). Chest physiotherapy is in fact not even mentioned as a treatment in major American paediatric textbooks. Current evidence does not support the use of physiotherapy in bronchiolitis (Panickar et al., 2008) because the key results are that chest physiotherapy does not make a significant difference to clinical score, duration of hospital stay or length of illness, although the sample in most of the studies consulted by this researcher were quite small, with unknown statistical power to detect differences before and after intervention (Panickar et al., 2008).

Studies have shown that postural drainage aggravates gastro esophageal reflux (GERS) in CP patients, and these head down positions (Trendellenburg) need to be adjusted to non-tipped positions. In neonatal Intensive Care Units (NICU) and Paediatric Intensive Care Units (PICU) it was found that neurological sequelae do exist following the use of physiotherapy, particularly in low birth weight (LBW) infants and if the

application of chest physiotherapy is too vigorous (McIlwaine, 2006). Adaptation of techniques might therefore be the answer, such as simply positioning patients on their side and thus altering ventilation. The prone position has been found to increase PaO₂ by as much as 10 per cent, although this is not always very practical in the PICU (McIlwaine, 2006).

Rib fractures are another complication that clinicians should be aware of, although the incidence is fairly rare (one to a 1,000 infants hospitalised for bronchiolitis and pneumonia, with a median age of three months). Chalumeau et al. (2002) found that percussion and the positive expiratory pressure technique (transcutaneous tracheal compression and increased expiratory flux) were the main culprits (Chalumeau et al., 2002). In this study all the participants received daily chest physiotherapy (for an average of one week) one month before the diagnosis of rib fractures was made. In other cases, rib fractures have been reported in premature neonates who received percussion. (Rib fractures are evident in 0.6 per cent of premature infants without rachitis). However, rachitis and osteoporosis, also known as “bone frailty”, play a major role in the increased risk of rib fractures. Even severe coughing can be a cause of rib fractures (Chalumeau et al., 2002).

Rib fractures can be caused by chest physiotherapy, but the underlying reason for these fractures could also be the consequence of insufficient training in technique and lack of adaption to the patient’s respiratory status. Chest physiotherapy involves interaction between technique, therapist, patient and disease. This relationship is more obvious with paediatric patients, especially young infants, where more passive techniques like the IEF are applied. Adaption of techniques such as forced expiration technique, postural drainage, percussion and suctioning is necessary to limit the incidence of adverse effects.

If not well performed, the IEF may be dangerous to the infant. If the physiotherapist applies too much force, this can cause the closing of the bronchiole or may even hurt the patient. On the other hand, if too little

pressure is applied, the technique is inefficient (Marechal et al., 2007). No side effects of IEF and similar techniques have been reported. A recent national consensus statement concluded that this technique was safe and effective in treating bronchiolitis (Chalumeau et al., 2002).

For all these reasons, chest physiotherapy should be considered a potential, but very rare, cause of rib fractures (Chalumeau et al., 2002).

Conclusion

Internationally, bronchiolitis in paediatric populations brings with it complications and high cost implications. Although various techniques are applied in clinical settings, claiming to either decrease the length of hospital stay, duration of the illness or severity of symptoms, very little evidence currently exists for the treatment of non-ventilated acute paediatric bronchiolitis. Unfortunately, in various clinical settings, chest physiotherapy techniques are used in paediatric patients with bronchiolitis (0 to 24 months) without the necessary indications or objective outcomes measures. The role of chest physiotherapy in the treatment of acute paediatric bronchiolitis must therefore be determined and this could add information to the body of knowledge of physiotherapy in the field of bronchiolitis, helping to confirm or refute current literature.

CHAPTER 3

Methodology

1. INTRODUCTION

In this chapter the methodology followed in the study is discussed. The search procedure, eligibility criteria and the sampling technique are explained first. Secondly, the measurement instruments used to appraise the studies, the reliability and validity of these instruments as well as the grading and categorisation of the synthesised data will be discussed.

2. RESEARCH DESIGN

The research design of this study is a systematic review.

In order to answer research questions regarding the effects of intervention, it is better to use a review of various trials than base findings on an individual trial, as reviews increase the precision of the results (Herbert, Jamtvedt, Mead & Hagen, 2005, p. 31).

Systematic reviews have an explicit methodology compared to narrative reviews that were used especially in the 1970s (Herbert et al., 2005). High quality systematic reviews have particular characteristics such as a specific research question, an adequate search strategy and appropriate inclusion criteria and therefore aims to provide a comprehensive, transparent but minimally biased overview of literature (Herbert et al., 2005; Moseley et al., 2002). Assessing the quality of included studies is essential when undertaking a systematic review (Tooth, Bennett, McCluskey, Hoffmann, McKenna & Lovarini, 2005). In this study, the researcher complied with these guidelines for conducting a systematic review of high quality.

2.1 Systematic reviews defined

Systematic reviews synthesise results from a sample of primary studies, a structural analysis of previously conducted research. Such reviews establish whether scientific findings are consistent and can be generalised across populations, settings, and treatment variations (Mulrow, 1987; TheFreeDictionary, n.d.). If valid and reliable, the information from these reviews can be used in the formulation of clinical practice guidelines. The patient's preference and clinical settings should also be kept in mind when formulating clinical practice guidelines, as stated in the definition by Field and Lohr (1990): "clinical practice guidelines are systematically developed statements to assist practitioner *and patient decisions* about appropriate health care for specific circumstances" (Field & Lohr, 1990, p. 38).

The research question, as stated in Chapter 1, guided this systematic review in order to determine the best current evidence regarding percussion, postural drainage and suctioning in paediatric patients newborn to 24 months with bronchiolitis.

2.2 Advantages and disadvantages of a systematic review

Health-care providers, researchers and policy makers are overwhelmed by unmanageable quantities of information; systematic reviews efficiently integrate existing information and provide information that allows for rational decision making. The systematic review is an efficient scientific technique. Although sometimes time consuming, a review is usually quicker and less costly than embarking on a new study, especially if similar studies have already been done (Mulrow, 1987).

The search strategy and process of study selection followed in this study is demonstrated in Figure 2.1.

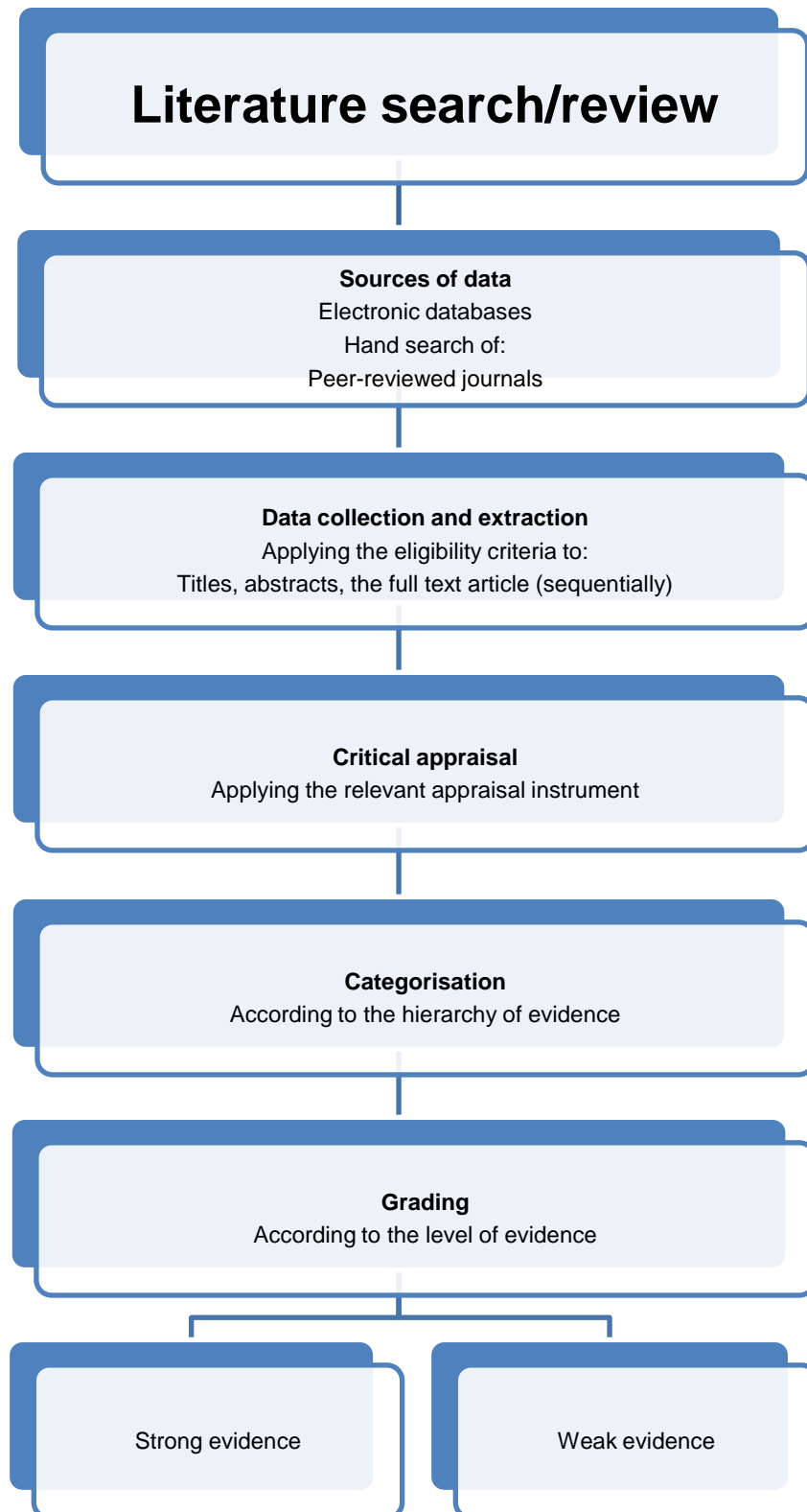


Figure 2.1 Research process

3. SELECTING DATA SOURCES

The study population comprised articles in 11 electronic databases available from the University of Pretoria Library. The databases were selected based on information from the following sources:

- Experts in the field of research and systematic review
- Information specialists at the Medical Library, University of Pretoria
- Literature on conducting systematic reviews and systematic reviews published in peer-reviewed journals.

Apart from the well-known databases like Medline, a physiotherapy specific database indexing randomised controlled trials and systematic reviews PEDro, was included. PEDro was essential to the study as it includes only physiotherapy-related articles including articles not published in prominent peer-reviewed general medical journals. Only three per cent of the records in PEDro have been published in prominent peer-reviewed general medical journals such as *Lancet*, *the Journal of the American Medical Association* (JAMA) and physical therapy journals such as *Physical Therapy*, *Physiotherapy*, *the Australian Journal of Physiotherapy* and *Physiotherapy Canada* (Maher et al., 2008).

In addition, two sources of grey literature and theses/dissertations were also included in the search in an effort to include unpublished studies and therefore decrease publication bias (Answers.com, n.d.). Grey literature is defined as information or documents issued outside the formal and mostly used channels of publication and distribution and cannot be found as easily through conventional channels. Examples of grey literature include congress abstracts, scientific reports, observational reports, non-profit reports, government documents, and theses (University of Ottawa, 2010). Therefore the Sabinet and University of Pretoria Electronic Theses and Dissertations Collection (UPeTD) databases were also searched.

4. DATABASE SEARCH

The following databases were searched by applying the specific search strategy for each database for recent information, i.e. articles published over the past 15 years. Search protocols can be found in Appendix B.

- African Health Line
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- The Cochrane Library
- EbscoHost
- Emerald
- University of Pretoria Electronic Theses and Dissertations Collection (UPeTD)
- Medline (Ovid)
- The Physiotherapy Evidence Database (PEDro)
- Sabinet Online Reference Services
- Science Direct
- Up To Date

Searches were conducted during the time frame October 2008 and March 2009.

4.1 Hand search

A secondary search of prominent, peer-reviewed specialist physiotherapy journals was undertaken in order to ensure the inclusion of all possible articles dealing with paediatric bronchiolitis chest physiotherapy interventions and to guard against overlooking certain essential studies through the limitations of the keywords. The following physiotherapy peer-reviewed journals were hand searched for articles published in the past 15 years:

- *Australian Journal of Physiotherapy*
- *Canadian Journal of Physiotherapy*
- *Physical Therapy* (United States of America)

- *Physiotherapy* (United Kingdom)
- *South African Journal of Physiotherapy*

4.2 Snowballing

The reference lists of all included full text studies were examined to make sure that all pertinent information to this study and relevant associated articles have been found. Snowballing is a method that is commonly used in narrative reviews and systematic reviews (Jeon, Merlyn & Chenoweth, 2010; McKenzie, Scott, Campbell & McClure, 2010).

4.3 Keywords and MeSH terms

The following keywords and Mesh terms were used:

(e.g. Medical Subject Headings (MeSH) term: physiotherapy and percussion):

- Physiotherapy and percussion/percuss*¹
- Physiotherapy and postural drainage/postural drain*
- Physiotherapy and suction/suction*
- Physical therapy and percussion/percuss*
- Physical therapy and postural drainage/postural drain*
- Physical therapy and suction/suction*
- Bronchiolitis and percussion/percuss*
- Bronchiolitis and postural drainage/postural drain*
- Bronchiolitis and suction/suction*
- Bronchiolitis and paediatric/paediatric*
- Bronchiolitis and pediatric/pediatric*

¹ * truncation

The truncation function was used to ensure that all word variants were accounted for, therefore ensuring a larger study frame.

4.4 Pilot study

Each database offered various search strategies, ranging from “basic search” to “advanced” or “experienced” search. As a standardised measure, the researcher did a “pilot” search on each database to determine which search strategy would render the greatest number of studies. The search terms used for the pilot search were “bronchiolitis and percussion”. Both the “basic” search and “advanced” search were applied, and the one that rendered the highest number of studies was chosen as the search strategy for that particular database. However, in cases where all the strategies rendered the same number of studies, the “basic” or “quick search” option was applied.

Every search done by the researcher (AH) was documented according to the number of citations found, and the titles of these studies were saved in electronic and hard copy format for later phases of data extraction. The external researcher (KM) conducted the searches according to the specific search strategy determined for that particular database, documented the results and saved all the citations for later comparison.

After each database had been searched by the external researcher, the data collectors (see Table 3.1) compared search results. This was done in order to determine discrepancies, to eliminate problems arising from the search strategy and to reach consensus regarding the specific number of citations found in each database. Where differences occurred, the cause was determined and, if the problem could not be resolved, the search was repeated by both the data collectors (AH, KM).

4.5 Eligibility criteria

4.5.1 Inclusion criteria

Criteria for inclusion of studies in critical appraisal process (Appendix C):

- Settings: Rural and urban clinics, public and private hospitals, as well as developing and developed countries
- Target population: All articles pertaining to infants two years and younger (i.e. newborn to 24 months)
- Main condition: Articles pertaining primarily to chest physiotherapy and bronchiolitis²
- Intervention: Articles pertaining to chest physiotherapy
- Language: Articles written in *all* languages
- Publication date between January 1993 and March 2009.
- Study types: Randomised controlled trials, qualitative, cohort, diagnostic studies, dissertations, case control and systematic reviews were included but commentaries, letters to editors and abstracts or conference proceedings were not considered.

As it was the interest of the researcher to determine what *current* research has been done, relevant, recent studies were included whilst studies using outmoded methods were excluded (Turkelson & Hughes, 2006).

² Refer to Chapter 1 for operational definitions

The reason why all study types were included, in contrast to conventional review methodology, was that different types of studies, including qualitative, can address many healthcare questions and furthermore inform evidence-based practice.

Although qualitative studies do not establish probability estimates or effect sizes, they can provide important support for quantitative outcomes found as well as identify patient priorities, preferences and concerns (Goldsmith, Bankhead & Austoker, 2007).

4.6 Process of data collection and extraction

Table 3.1 Summary of data collectors and reviewers

Name	Activity/phase of research	Abbreviation
Anri Human	Primary researcher	AH
Karien Mostert-Wentzel	Study leader and 2 nd reviewer of studies (appraisal)	KMW
Kelebogile Montsho	Final year physiotherapy student: data collection	KM
Frida Kotsokoane	Physiotherapy lecturer: eligibility criteria	FK
Prof. Efe Useh	Senior physiotherapy lecturer: arbitrator	EU

The first phase of the data collection process comprised “screening” by the researcher of all included study titles from all databases. A numbering sheet (Appendix D) was used to mark the titles included/excluded for each of the keywords and each database individually. This inclusion/exclusion process was done by the main researcher (AH) as well as an external researcher (FK) who was not involved in the “original search procedure”. The external researcher evaluated the article titles based on the eligibility criteria provided by the researcher. If in doubt as to whether

to include an article or not, the researcher included the title, as articles would be subjected to a further evaluative process on the relevance of their abstracts or full text.

Once the external researcher had applied the eligibility criteria, the researcher compared the results. Where both parties agreed that a study title should be included, it was recorded as part of the sample. Where discrepancies occurred and the researchers could not agree, arbitration was requested by a third external researcher (EU). These arbitrated articles then became part of the “included post-arbitration” sample. The Medline results (Figure 3.1 below) illustrates the process graphically.

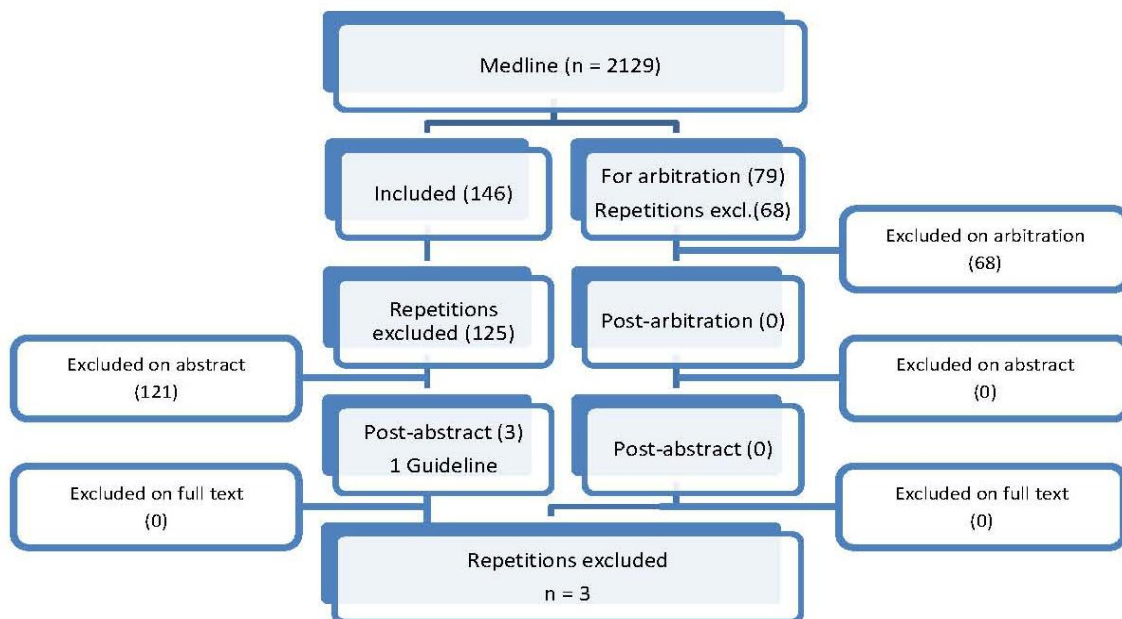


Figure 3.1 Example of the flow of studies in a specific database

For Medline the process resulted in two “sample sets” for each database: the study titles that “both included”, referring to those articles included by both the researcher and the reviewer, and those that were “included post-arbitration”, referring to titles included after deliberation and arbitration. Any study that was repeated within one of these sample subsets was excluded. The final exclusion of duplicate studies was

made at the end of the extraction process. Articles which were found to be eligible, based on the assessment of their titles, were evaluated by the researcher according to their abstracts. If the researcher was in doubt about the inclusion of a study based on its abstract, the protocol was to include it as it would be subjected to a further evaluative process on the relevance of its full text.

Lastly, the studies that were included (based on their abstracts, i.e. “post-abstract”), were reviewed according to their full text. The eligibility criteria were applied in order to determine which studies to appraise. Furthermore, the reference lists of all included studies were searched to ensure that *all* articles used by other studies were included, thus ensuring saturation.

A data extraction/summary table was adapted from Goldsmith et al (2007). This comprised the following headings: title, author(s), date, database, research/study design, sample size, study population, outcomes measures, findings/results and conclusion (Appendix E). This form was used only for the studies included in the sample (those which were appraised). A summary of the sample in table form can be found in Chapter 4 ([Section 2.4](#)).

5. APPRAISAL INSTRUMENTS

Critical appraisal is the ability to assess the validity and clinical applicability of evidence and its support for clinical practice (Sackett et al., 1987 in Domholdt, Flaherty & Phillips, 1994). Critically appraising literature assists in refining search results and retrieving more relevant references of a higher quality (Paisley, 2010). Relevant studies are those conducted in such a way that their results can effectively be applied to the greater population.

The following two research instruments were used in the critical quality appraisal of the included studies. These instruments were chosen for their reliability, validity and wide use throughout the literature (CASP instruments) and systematic reviews (CASP instruments and the PEDro scale) (Bhogal, Teasell, Foley & Speechley, 2005; Bleakley, 2008; Maher, Sherrington, Herbert, Moseley & Elkins, 2003; Reilly, Barker & Shamley, 2006; Smith, Davies & Donell, 2009; Tooth et al., 2005).

5.1 Instruments

5.1.1 Critical Appraisal Skills Programme (CASP)

In cases of therapy or treatment intervention, the highest possible level of evidence comes from a systematic review or meta-analysis of randomised controlled trials (RCTs) or from an individual randomised controlled trial (Patient UK, 2010). All the studies appraised in this research study were randomised controlled trials or a systematic review.

The CASP was developed by the Public Health Resources Unit (PHRU) in the United Kingdom (UK) and the programme of the North Thames Research Appraisal Group (NTRAG) in 1993 (Bessa-Nogueira, Vasconcelos & Niederman, 2008). This programme assists in developing an evidence-based approach to health and social care (PHRU, 2007).

The CASP developed appraisal instruments for various types of studies, including randomised controlled trials, systematic reviews, cohort studies, diagnostic studies, case control and even qualitative studies. These instruments were developed to address the epidemiological principles behind the study types, with particular emphasis on assessing study validity. Each appraisal instrument consists of two sections. Section 1 is made up of screening questions while Section 2 contains more detailed questions. The screening questions determine whether it is worth continuing with further appraisal of the specific article. The detailed questions have the options "Yes", "Can't tell" and "No". Furthermore, Section 2 is divided into three themes,

namely internal validity, results and relevance to practice. Examples of these appraisal instruments are to be found in Appendix F.

A scoring system for the CASP appraisal instruments was developed by the researcher. A score of one mark was awarded if a criterion was addressed adequately, half a mark if it was only partially addressed and zero if the criterion was either not reported at all or insufficiently addressed. This is similar to the process used by Bessa-Nogueira et al. (2008) who calculated the mean number of “Yes”, “Can’t tell” and “No” answers (Bessa-Nogueira, et al., 2008). The CASP score(s) were converted to a mark out of 10, to compare to the PEDro score(s) which are out of 10.

The PEDro scale was used in conjunction with the CASP instrument for randomised controlled trials. The researchers could therefore compare the CASP results to the PEDro scale when appraising randomised controlled trials.

5.1.2 PEDro Scale

The PEDro scale was developed by the Centre for Evidence Based Physiotherapy (CEBP) and was originally designed to address methodological issues in studies in physiotherapy (PEDro, 2010).

The PEDro scale consists of 11 items and, like CASP’s Section 1, the first item determines whether it is worth continuing the appraisal. This item does not contribute to the score, however. The remaining ten items each receive a “Yes” (1) or “No” (0) score, so the total of the PEDro is ten. From ten points, three are allocated to the methods of blinding used, two points to randomisation procedures, two points to the reporting of appropriate data and one point to analysis as well as adequacy of follow-up (Bhogal et al., 2005).

Tooth et al. (2005) reported that although the PEDro scale was a reliable instrument for rating randomised controlled trials, they revised the scale in order to improve its

reliability. Revised rating guidelines for difficult scale items were developed and this improved the inter-rater reliability (Tooth et al., 2005). Unfortunately, despite numerous internet searches and attempts to contact the authors, this researcher (AH) was unable to access a copy of the revised PEDro scale. The original PEDro scale was thus applied in this study (Appendix G).

6. VALIDITY

Validity is the extent to which an instrument actually reflects the abstract concept being examined (Burns et al., 2005). In other words, it is the extent to which an instrument measures what it is intended to measure (Hek et al., 2002, p. 140). The methodological features of randomised controlled trials (internal validity), such as random allocation, concealment of allocation, similarity of groups at baseline, blinding of participants, assessors and therapists, adequate follow-up and the “intention-to-treat” analysis, reduce the chance of bias and/or subjectivity (Tooth et al., 2005). There are various types of validity; the types relevant to this study were construct validity, content validity, and face validity. These validity types are defined below (ChangingMinds.org, 2010; Social Research Methods, 2006).

6.1 Construct validity:

Construct validity is an assessment of the quality of an instrument or experimental design. “Does it measure the construct it is supposed to measure?” If a study does not have construct validity, the researcher may draw incorrect conclusions.

Construct validity will also determine whether the inferences made from a certain study can be generalised to a greater population or sample.

6.2 Content validity

Content validity exists when the experiment provides adequate coverage of the subject being studied. This includes measuring the right things, therefore having the correct content.

6.3 Face validity

Face validity exists where something *appears* to be valid. This, of course, depends very much on the judgment of the observer. In any case, it is never sufficient and requires more solid validity to enable acceptable conclusions to be drawn.

7. RELIABILITY

Reliability is the extent to which a test or a procedure is reproducible or repeatable (Edwards & Talbot, 1994 in Smith et al., 2009; Polgar & Thomas, 2000). It is also stated as the consistency of the measurement, or the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects (Social Research Methods, 2006).

7.1 Inter-tester reliability

This can be defined as the evaluation of the degree to which different evaluators make consistent estimates of the same test (Portney & Watkins 2000, in Smith et al., 2009).

7.2 Intra-tester reliability

This can be defined as the evaluation of the consistency of a measure on two different occasions (Polgar et al., 2000, Portney et al., 2000, in Smith et al., 2009).

7.3 CASP

The validity of the CASP appraisal instruments was ensured by the following procedures during their construction (PHRU, 2007):

- A multidisciplinary working group, with a background in public health, epidemiology or evidence-based practice, based the scale on a literature review of methodologies, other appraisal scales as well as checklists for critical appraisal.
- The working group (n=unknown) tested the critical appraisal instruments using a workshop and questionnaire feedback approach with health care professionals as well as non-expert health staff matters, and modified the instrument accordingly.

7.4 PEDro scale

The PEDro scale was chosen for its widespread use in literature as previously stated, as well as the discriminative and face validity of its 11 items. In addition, the PEDro scale requires that studies provide details of important aspects of their methodology, because scoring is based on specific criteria (Bleakley, 2008).

Unfortunately, no statistics or types of validity were reported on in Bleakley et al.'s article.

Also widely used is the Jadad scale, but this was originally designed to address methodological issues in pain studies (Bhogal et al., 2005) and it appears that Jadad's quality criteria cannot be applied in interventions that cannot be double blinded. Therefore, the Jadad scale was not used in this study. Bhogal et al. (2005) found that, when compared to the Jadad scale, PEDro provided a more comprehensive measure of methodological quality in stroke rehabilitation literature (Bhogal et al., 2005).

As a widely used and validated quality assessment instrument, the PEDro scale has shown to be sufficiently reliable for use in systematic reviews (Maher et al., 2003). It is also a reliable instrument for rating the quality of randomised controlled trials. Tooth et al. (2005) found that the reliability of the PEDro scale items varied from

“fair” to “substantial”, but the total PEDro score was found to be “fair” to “good” (Maher et al., 2003; Tooth et al., 2003). Intra-tester as well as inter-tester reliability was evaluated: reliability of ratings of the PEDro scale items was calculated by making use of multi-rater kappas and the reliability of the total PEDro score was calculated using intra-class correlation coefficients (ICC). The kappa value for each of the 11 PEDro scale items ranged from 0.36 to 0.80 for individuals and 0.50 to 0.79 for consensus ratings generated by different groups of two or three raters. The ICC for the total PEDro score was 0.56 (95% confidence interval (CI): 0.47, 0.65) for individual assessor ratings; the ICC for the consensus ratings was 0.68 (95% CI: 0.57, 0.76) (Maher et al., 2003). The total PEDro score was rated as having moderate reliability (ICC: 0.54, 95% CI: 0.39, 0.71). These reliability coefficients relate to judgements made by only one evaluator. Reliability improves if a study is rated by two evaluators and if a consensus is not reached, a third arbitrator can be used (Sherrington, Herbert, Maher & Moseley, 2000).

As an initial novice in appraisal techniques, the researcher included an expert physiotherapist as external “evaluator” to appraise the final articles, using both the CASP system and the PEDro scale. This added to the value of the results by limiting subjectivity (Domholdt et al., 1994) due to inexperience.

8. STRATEGIES TO AVOID BIAS

Randomised controlled trial quality can be defined as “the likelihood of a trial design to generate unbiased results that are sufficiently precise and allow replication in clinical practice” (Maher et al., 2003).

8.1 Studies of high methodological quality

The risk of bias in individual studies was appraised and studies that scored lower than 45 per cent on the appraisal tool/instrument were excluded from the final sample.

8.2 Number of raters

The selection process was carried out individually by the two evaluators and they were blinded to each other's results. When consensus could not be reached between the evaluators, a third external researcher had to arbitrate.

Two researchers evaluated the articles. Where differences between the researchers occurred there was discussion until consensus was reached.

Inter-rater reliability between the evaluators or assessors was not calculated, because every phase of the study was verified by a different external researcher (Refer to [Table 3.1](#)).

8.3 Publication bias

Systematic reviews are performed in order to find and assess all high quality studies addressing the question of the review, but identifying all relevant studies is not always possible. This is in part because studies with significant positive results are easier to find than those whose results are less significant or "negative". The subsequent over-representation of positive studies in systematic reviews may mean that reviews are biased toward a positive result and the wrong conclusions might be drawn if studies are not representative of all that have been carried out in that particular field (The Cochrane Collaboration, 2002).

Therefore the researcher attempted to identify unpublished studies from other sources than peer-reviewed journals. These sources included grey literature such as theses and dissertations. Congress material was considered to avoid being biased in favour of articles published only in major peer-reviewed journals (which tend to yield significant results). This meant that studies on bronchiolitis using smaller samples, even those with less significant results, could be included. Informal interviews with

experts in the field of paediatric chest physiotherapy were also conducted in order to add to the depth of knowledge and identify other sources and studies of interest.

8.4 Selection and retrieval bias

Selection bias (Schulz & Grimes, 2006) was avoided by establishing the eligibility criteria before the study commenced, and retrieval bias (Porter, 2008) was avoided by making use of a specific, tailored search strategy for each database. The review protocol was developed and followed during the study in order to decrease selection bias and prevent threats to the feasibility as well as “scope creep”. “Scope creep” can be described as the change in a project's scope after the work has already started. The scope expands with the addition of new features to the inclusion and exclusion criteria. As a result, the project can drift away from its original purpose, timeline and budget (mariosalexandrou.com, 2010).

8.5 Language bias

Most articles in electronic databases and in peer-reviewed journals are published in English (Porter, 2008). Ignoring trials in other languages can be problematic, especially as there is such a small body of research published on paediatric bronchiolitis. In an attempt to minimise language bias, *all* languages were included. Various studies in French and Spanish were found on the subject of paediatric bronchiolitis and these were then translated into English by a software programme (Google translate). On consideration of the abstract and then of the full text, each article was either included in the sample or rejected.

8.6 Multiple publication bias

Multiple publication bias refers to studies that are likely to be published more than once (The Cochrane Collaboration, 2002). In this systematic review, this form of bias was avoided by checking that each article in the final sample reported a unique study.

8.7 Meta-analysis

Data analysis is conducted in a study to reduce, organise and give meaning to the data collected (Burns et al., 2005). Meta-analysis can be described as the method used to combine results of individual trials, therefore giving a combined result from a number of trials, thus to summarise the effects of interventions (Herbert et al., 2005). In this study a meta-analysis was not possible as the studies included (randomised controlled trials and a systematic review) were too varied in terms of methods applied, different outcome measures (e.g. respiratory distress score, clinical score, and nasogastric feeding) and the trials included reported incomplete data (e.g. no standard deviations), therefore data could not be combined or compared.³

9. HIERARCHY OF EVIDENCE

Hierarchy of evidence is defined as a means of judging evidence presented in medical literature. Criteria for judging include how the clinical subjects were selected, the nature of the control group, the method of data collection, and how the statistics were analysed (TheFreedictionary, n.d.).

The phrase "best available evidence" is used quite frequently by clinicians, including physiotherapists, but one needs to have a clear knowledge of the hierarchy of evidence to fully understand what "best available evidence" actually entails. Placing the available literature on a hierarchy allows for a clearer understanding when discussing studies, especially when conducting a systematic review to establish recommendations for practice (Petrisor & Bhandari, 2007).

Various grading systems exist to determine the strength or weakness of synthesised evidence which will in turn determine the recommendations made.

³ See the section on the Compact Disc "Meta-analysis" for an example of an "artificial" meta-analysis using only one common outcome variable between the studies.

Examples of some grading systems found in the literature are:

- The hierarchy of evidence by Hek et al. (2002). This grading system was originally included in the protocol of the study, but was found to be lacking in sufficient detail (e.g. description of inclusion criteria for each level) for use in a systematic review (Hek et al., 2002).
- GREG grading system consists of three broad levels, namely A, B and C grading, and was also deemed to be lacking in detail regarding specific subsections and the inclusion criteria for each (Low, medium and high) (Patient UK, 2010).
- The SIGN (Scottish Intercollegiate Network) with grading A to D and 1 to 4 was found to be unsuitable for this study because the differentiations between the various grading levels were in certain instances vague and not clearly defined (SIGN, 2006).
- Sackett et al. (2000) with grading A to D, with subsections and description of inclusion and types of study for each subsection is given (Table 3.2) (Sackett, Straus, Richardson, Rosenberg & Haynes, 2000).

The hierarchy or grading system used by Sackett et al. (2000) is widely referred to in the medical literature and is used by the SASP for the grading of evidence. As this hierarchy contains a detailed description of categories A to D, and because its use is documented generally in medical literature and specifically in physiotherapy literature, this hierarchy was used in the grading of the results and synthesis of evidence in this study (Sackett et al., 2000).

The included studies were appraised and categorised according to the hierarchy of evidence, as illustrated in Table 3.2:

Table 3.2 Grading system according to Sackett et al. (2000)⁴

Grade of recommendation	Level of evidence	Treatment/therapy/intervention/harm
A	1a	Systematic review (with homogeneity) of RCTs
	1b	Individual RCT (with narrow confidence interval)
	1c	All or no treatment
B	2a	Systematic review (with homogeneity) of cohort studies
	2b	Individual cohort study including low quality RCT e.g. < 80% F/U
	2c	“Outcomes” research
	3a	Systematic review with homogeneity of case control studies
	3b	Individual case control studies
C	4	Case series and poor quality cohort and case control studies
D	5	Expert opinion without explicit appraisal, or based on physiology, “bench” research and “1 st principles”

⁵

From the results found from the included studies the necessary recommendations regarding chest physiotherapy in infants from newborn to 24 months with bronchiolitis were made.

⁴ Only the subsection of studies about intervention/treatment included

⁵ Another grading system with systematic and explicit consideration of study design, quality and consistency that can be utilised is the GRADE hierarchy of evidence (BMJ. 2004 June 19; 328(7454): 1490.)

10. ETHICAL CONSIDERATIONS

As no clinical intervention was made in this study, permission was not requested from an ethics committee.

Permission is not required to use the CASP instruments when they are to be used for personal development and not for profit, which was the case in this study.

However, the producers and providers of the CASP instruments must be acknowledged (PHRU, 2007).

The PEDro scale is also in the public domain and can be used without permission from the developers.

11. SUMMARY

In this chapter the systematic review was defined and its advantages and disadvantages explained. The method used in the study was discussed in terms of the process and instruments. The various sources of evidence and the search strategies were described, as well as the process of data collection and extraction. Various appraisal instruments were explained and evaluated. The hierarchy of evidence and the method of grading the studies were defined and explained. The chapter concluded with ethical issues that were taken into consideration.

In the next chapter the results of this study will be reported and discussed.

CHAPTER 4

Results

1. INTRODUCTION

In this chapter, the selection of studies for the sample is discussed. Selection was made according to citations, abstracts and full text. Data extracted from the selected studies is provided in tabular form and appraisal of the studies using specified appraisal instruments. Finally, categorisation and grading of the selected studies are discussed. Flow diagrams and tables are used to illustrate these processes and findings.

2. DESCRIPTION OF SAMPLE

2.1 Results of the search

Figure 4.1a and Figure 4.1b reflects the total number of study titles, as well as those titles found in each database, and the number of studies from each database after full text evaluation. Figures 4.2 to 4.8 contain the detailed results of each individual database.

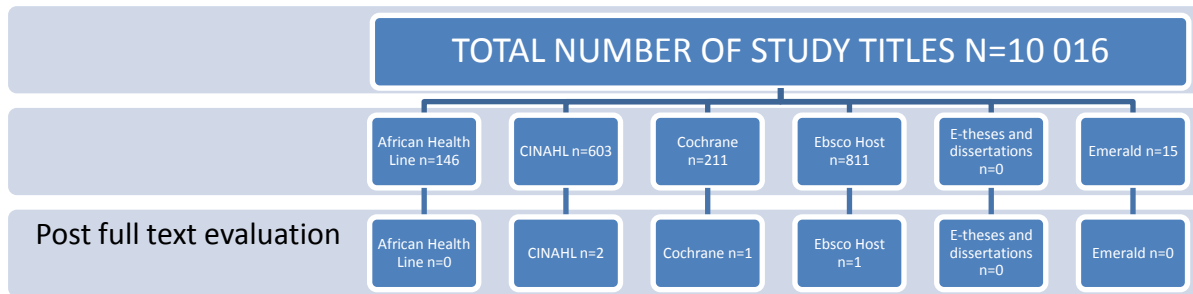


Diagram A

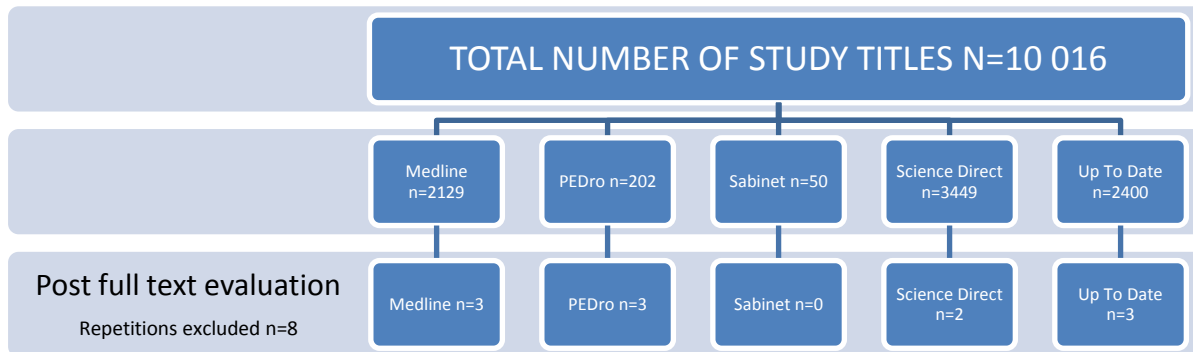


Diagram B

Figure 4.1a Flow chart of data extraction

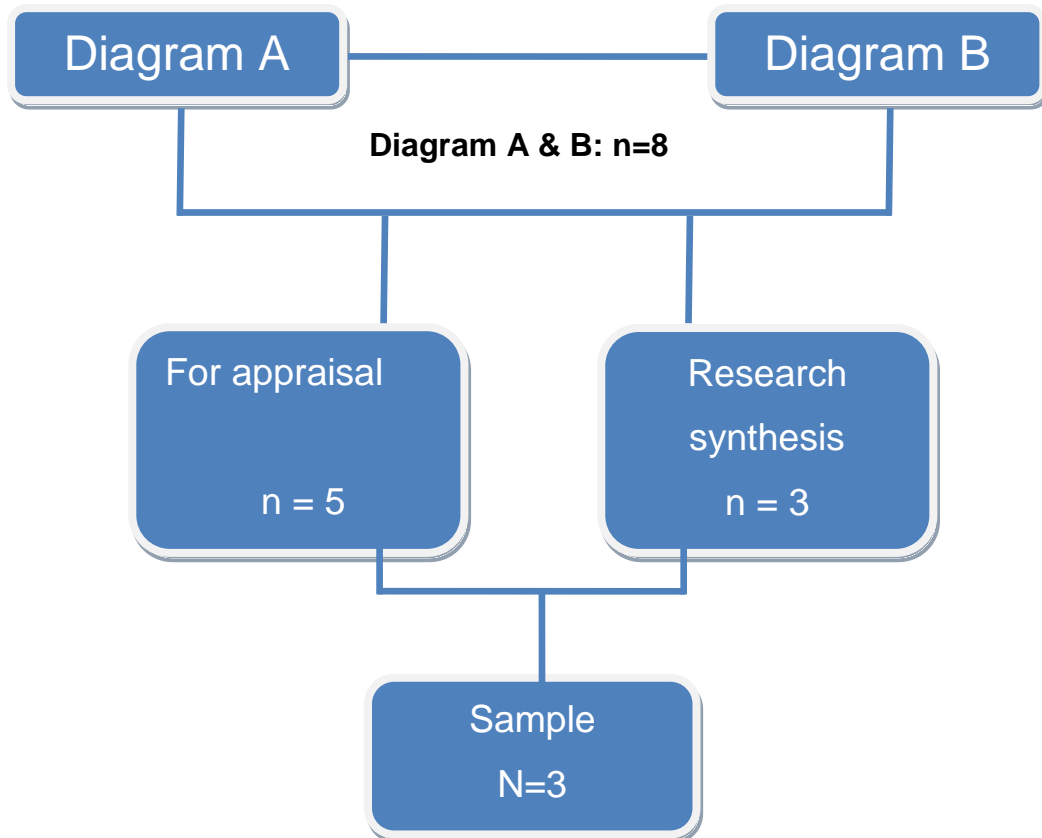


Fig 4.1b Flow chart of data extraction

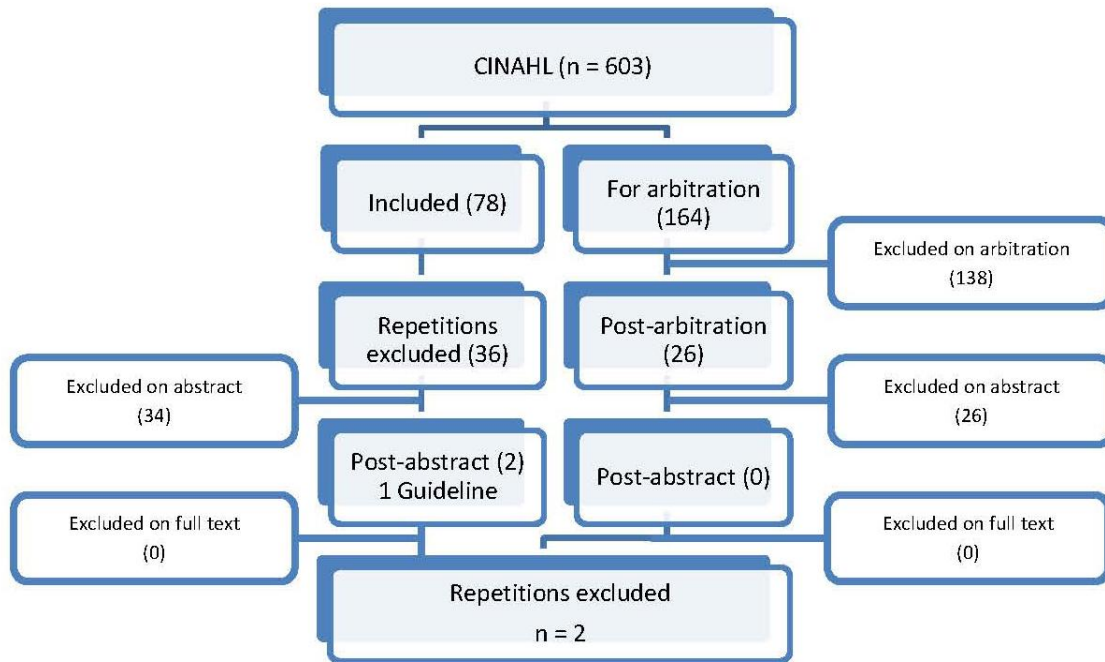


Figure 4.2 Flow of studies: CINAHL database

Diagrams like Figure 4.1a and Figure 4.1b were used to show the flow of studies for all the databases. Figure 4.2 reflects the results from the CINAHL database. In this case, the search yielded 603 relevant study titles. Of these, 78 were included by both researchers but this number was reduced to 36 after the exclusion of studies that appeared more than once within this sample. The number of studies that required arbitration was 164, and 26 of these were retained. Next, the abstracts were examined, after which, from the studies included by both researchers, only two remained and from those post-arbitration none remained. In conclusion: from the search of the CINAHL database, two studies complied with the inclusion criteria based on an evaluation of their full texts, and these were included in the sample.

Figures 4.3 to 4.8 depict the flow of studies for the other databases in a similar way.

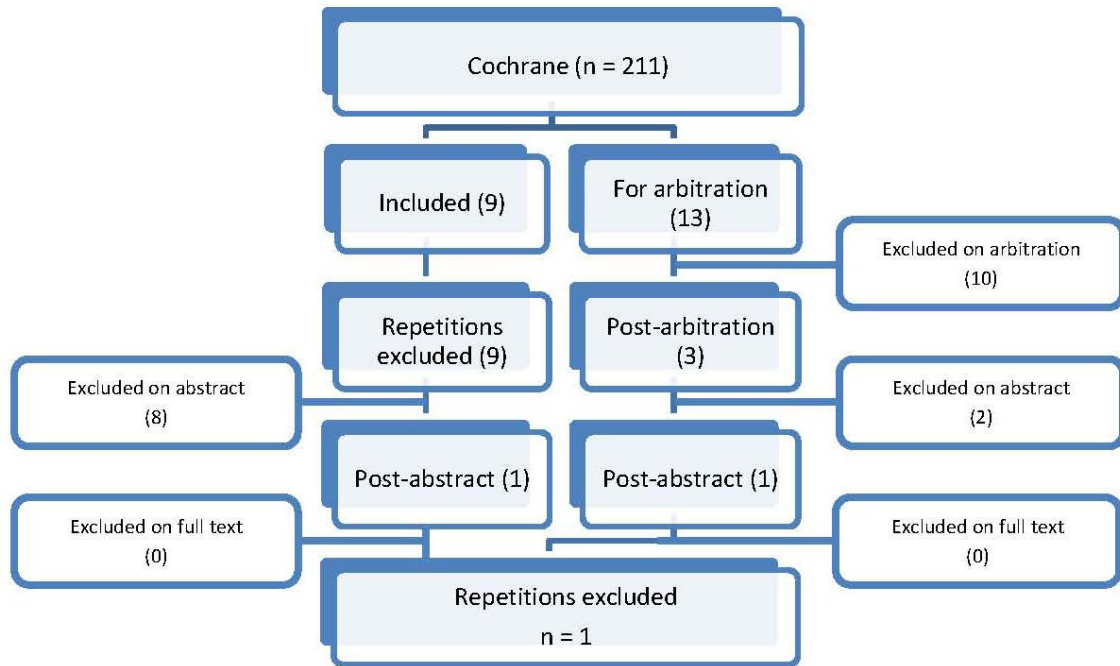


Figure 4.3 Flow of studies: Cochrane database

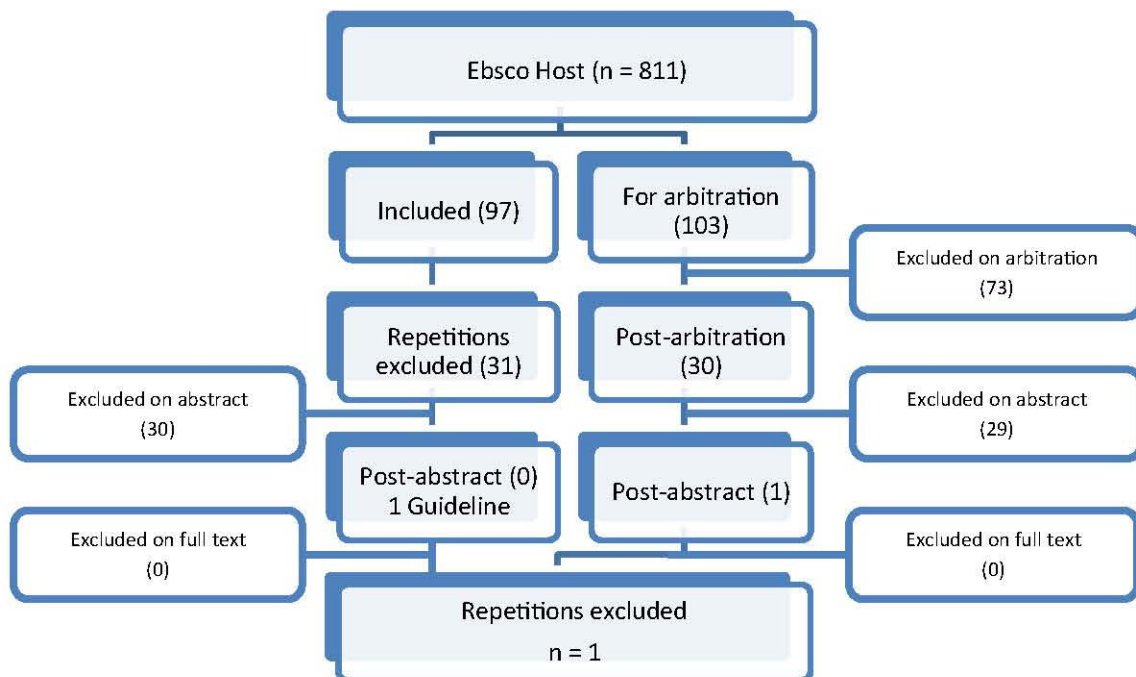


Figure 4.4 Flow of studies: Ebsco Host database

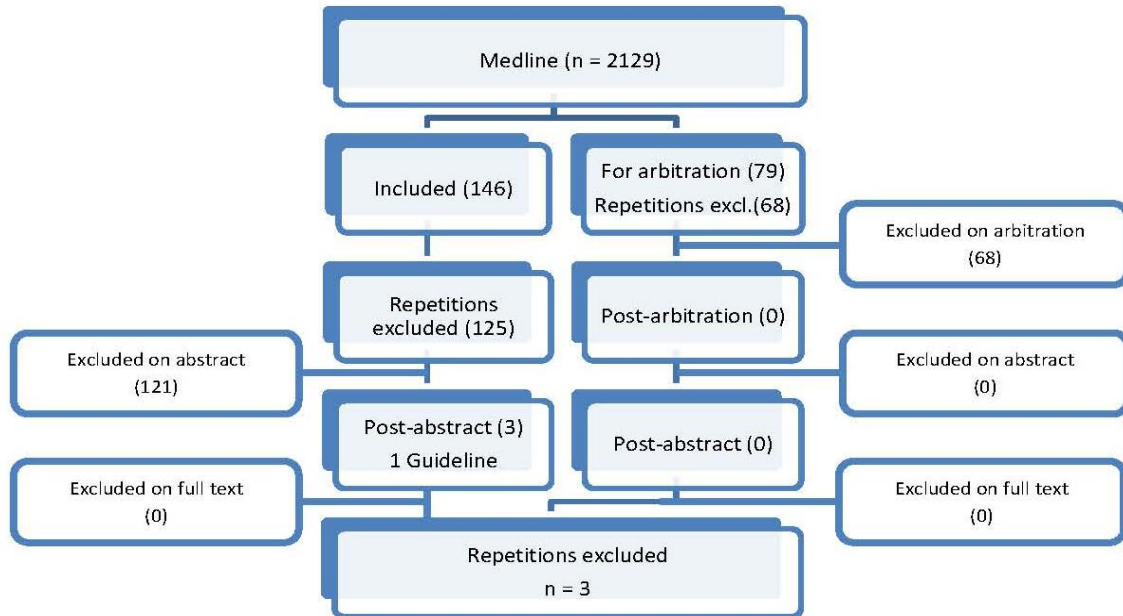


Figure 4.5 Flow of studies: Medline database

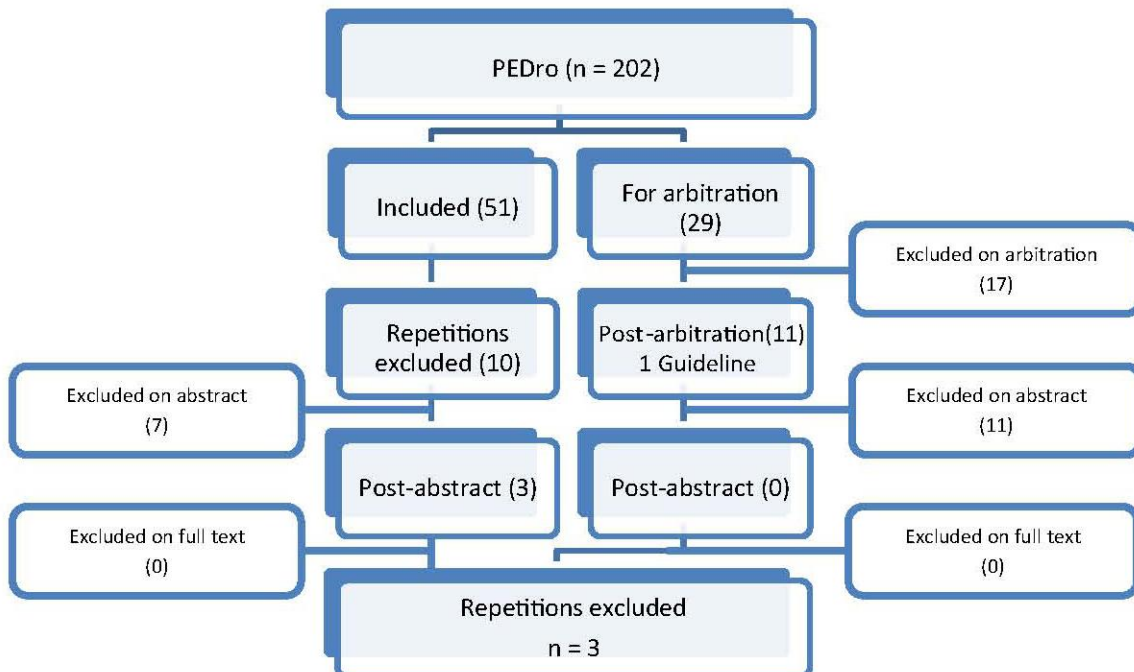


Figure 4.6 Flow of studies: PEDro database

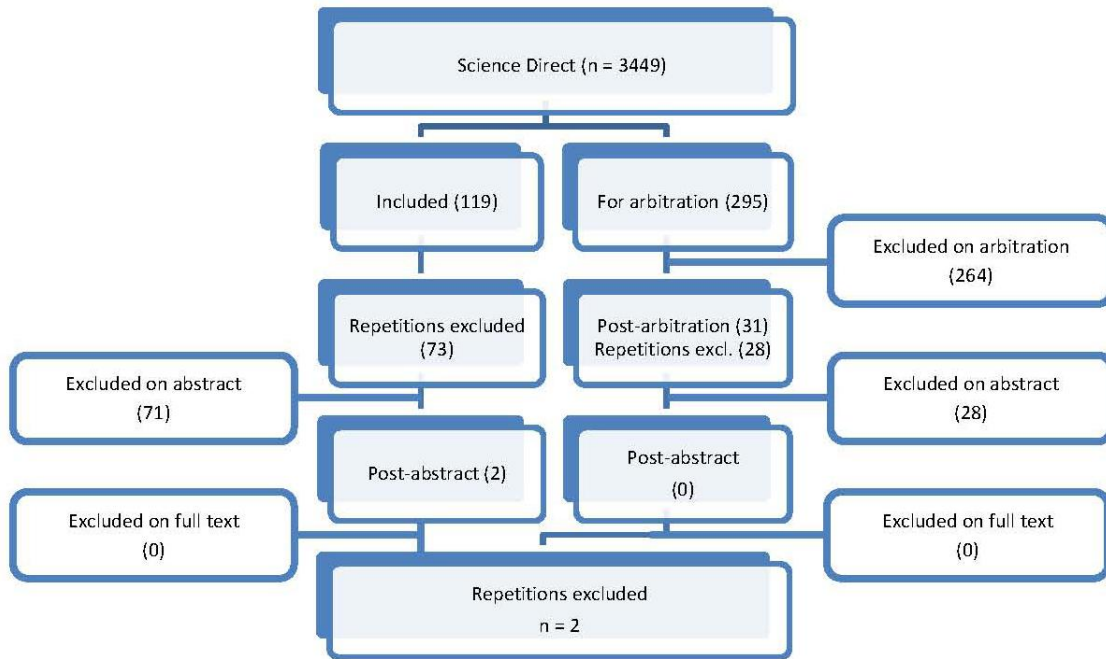


Figure 4.7 Flow of studies: Science Direct database

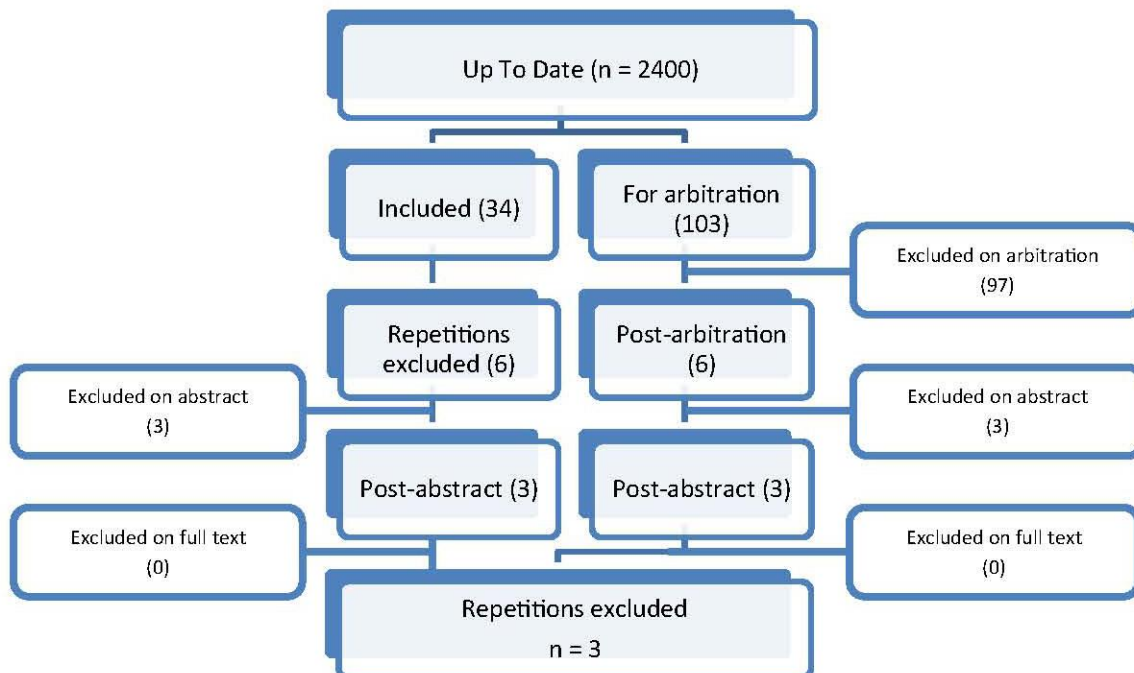


Figure 4.8 Flow of studies: Up To Date database

For the list of study titles from each database (Figure 4.2 to 4.8), refer to Appendix H.

Searches of African Health Line, Emerald, E-theses and dissertations (UPeTD), as well as Sabinet databases contributed no studies. For the figures of these abovementioned studies refer to the Compact Disc.

2.2 Hand searching

The hand searching of prominent peer-reviewed journals yielded no further articles.

2.3 Excluded studies

In order to prevent scope creep, studies that investigated the IEF were excluded as IEF was not part of the original scope of interventions (percussion, postural drainage and suctioning). Reasons for exclusion of other studies were:

Publication date earlier than 1993

Adult respiratory conditions, e.g. pulmonary sarcoidosis, emphysema, bronchiectasis

Adult cardiac and circulatory conditions, e.g. heart disease, myocardial infarction, coronary artery bypass graft (CABG), deep venous thrombosis (DVT)

Congenital heart disease

Paediatric respiratory conditions in patients older than two years

Paediatric respiratory conditions not related to bronchiolitis, e.g. cystic fibrosis, bronchitis

Asthma (not linked to bronchiolitis)

Bronchiolitis obliterans pneumonia, bronchiolitis obliterans and panbronchiolitis

RSV adult bronchiolitis

Diagnosis, complications, etiology and epidemiology of bronchiolitis

Allergic conditions e.g. sinusitis

Croup

Nosocomial bronchiolitis/hospital infection

Aspiration pneumonia

Rhinitis

Bronchopulmonary dysplasia (BPD)

Chronic cough referring to pathologies other than bronchiolitis

Smoke inhalation

Gastro Esophageal Reflux Syndrome (GERS)

Otitis media

Toxicology

Non-respiratory related physiotherapy conditions including neuromuscular disorders, e.g. lower back pain, migraine, shoulder injuries, Temporomandibular joint (TMJ), dyskinesia, amputations, wound care, abscess, low birth weight

Chronic conditions, e.g. cancer, haemophilia, systemic lupus erythematosus, sickle cell disease

Extubation

Pharmacological treatment including antibiotics

Lung injury

Brain injury

Organ transplant

Management of paediatric bronchiolitis, other than chest physiotherapy

Chest physiotherapy techniques other than percussion, postural drainage and suctioning, e.g. autogenic drainage, active cycle of breathing, vibrations, Positive Expiratory Pressure (PEP), Continuous Positive Airway Pressure (CPAP), manual hyperinflation

Inhalation and oxygen therapies

Mechanically ventilated or invasive ventilation therapy patients

Animal studies

De Boeck et al. (2008) (Review) and Beauvois et al. (2001) (Systematic review) received appraisal scores of below 45 per cent: De Boeck et al. scored 23 per cent and Beauvois et al. 29 per cent respectively when rated on the CASP appraisal system, and were therefore excluded (Beauvois et al., 2001; De Boeck et al., 2008). Webb, Martin, Cartlidge, Ng, & Wright, (1985) was found through “snowballing” of the reference lists of the included studies, but was excluded due to the article’s publication date (Older than 1993). However, as the study was found in various reference lists, it was the interest of the researchers to determine the quality of this study and see how it compares to more recently published studies (Refer to [Table 4.7](#) for the comparison).

For detailed appraisal results refer to Appendix I.

2.4 Included studies

The initial sample comprised randomised controlled trials (2), and systematic reviews (3). Research syntheses (3) were excluded. The final sample therefore consisted of two clinical trials and one systematic review.

The three studies that were included in the final sample are listed in Table 4.1.

Table 4.1 Included studies

Author	Date	Title
Nicholas et al.	1999	An evaluation of chest physiotherapy in the management of acute bronchiolitis: changing clinical practice.
Bohe et al.	2004	Indications of conventional chest physiotherapy in acute bronchiolitis (Spanish).
Perotta et al.	2008	Chest physiotherapy for acute bronchiolitis in paediatric patients between zero and 24 months.

See Tables 4.2 to 4.4 for the characteristics of these studies.

Table 4.2 Characteristics of the included systematic reviews

Author, date and database	Study design	Sample size	Population	Outcomes measures	Findings	Conclusion
Perotta C Ortiz Z Roque M (2008) Cochrane Medline PEDro	Systematic Review	Three randomised controlled trials	Infants < 24 months with acute bronchiolitis Non-ventilated No co-morbidities	Primary: -Severity -O ₂ saturation -Transcutaneous PCO ₂ Secondary: -Duration of O ₂ -Length of hospital stay -Use of bronchodilator & steroids	CPT using vibration and percussion does not: -Decrease length of hospital stay -Decrease oxygen requirement -Improve clinical score -CPT using Forced Expiratory Technique (FET) requires further investigation	Chest physiotherapy using percussion and vibration techniques cannot be recommended for hospitalised infants with acute bronchiolitis.

Table 4.3 Characteristics of the included randomised controlled trial (1)

Author, date and database	Study design	Sample size	Population	Outcomes measures	Findings	Conclusion
Nicholas KJ Dhouieb MO Marshall TG Edmunds AT Grant MB (1999) CINAHL PEDro Science Direct	Clinical trial (RCT)	50 infants	23 males 27 females Mean age: 2.8 months	Clinical score: -Clinical status -Length of hospital stay -Inspired O ₂ -Nasogastric feeding -SaO ₂	Clinical scores over five days (improvement in treatment group, not statistically significant) No statistically significant effect on: -Length of hospital stay -Requirement for supplemental O ₂ -Nasogastric feeding Less severely ill infants (clinical score <9.5) recovered at slower rate than control group (statistically significant). Saturation decrease between baseline and intervention (not statistically significant).	Patients with bronchiolitis should not be routinely referred for CPT. CPT does not decrease the intensity of the acute illness in these patients, can even slow recovery in moderately ill patients. CPT does not affect the progress of any infant with uncomplicated bronchiolitis. CPT does not cause distress in patients treated, because responsive CPT was applied.

Table 4.4 Characteristics of the included randomised controlled trial (2)

Author, date and database	Study design	Sample size	Population	Outcomes measures	Findings	Conclusion
Bohe L Ferrero ME Cuestas E Polliotto L Genoff M Spanish (2004) Medline PEDro	RCT	32 patients	< 24 months 16 treatment, 16 control group	Clinical score/respiratory distress Length of hospital stay	No decrease in length of hospital stay No significant improvement in the respiratory distress clinical score	Routine CPT does not produce clinically important benefits or decreased length of hospital stay in the treatment of acute bronchiolitis. Therefore no routine prescription of CPT in acute paediatric patients with bronchiolitis were advised.

3. METHODOLOGICAL QUALITY

3.1 Introduction

Consensus regarding the final scores for each study could be reached during the appraisal process and this made consultation with a third moderator unnecessary.

3.2 Example of appraisal scores

Tables 4.5 and 4.6 reflect the results from one of the research studies (randomised controlled trial) (Bohe et al., 2004), as an example of the evaluation of the PEDro scale and CASP instrument respectively. Similar results for the other studies are provided in Appendix I.

Table 4.5 PEDro Scale (Randomised controlled trial) for Bohe et al. (2004)

PEDro Scale item	Score (AH)	Score (KMW)	Average or negotiated score
1. Eligibility criteria specified	1	1	1
2. Random allocation	1	1	1
3. Concealed allocation	1	1	1
4. Groups similar at baseline	1	0.5	0.5
5. Participant blinding	N/A	N/A	N/A
6. Therapist blinding	N/A	N/A	N/A
7. Assessor blinding	0	0	0
8. Less than 15% drop out	1	1	1
9. Intention-to-treat analysis	1	1	1
10. Between-group statistical comparisons	1	1	1
11. Point measures and variability data	1	1	1
TOTAL	7/8	6.5/8	6.5/8
TOTAL %	88%	81.3%	81.3%

Table 4.6 CASP factors (Randomised controlled trial) for Bohe et al. (2004)

CASP item: Detailed questions	Score (AH)	Score (KMW)	Average or negotiated score
1. Did the study ask a clearly focused question?	1	1	1
2. Was this a randomized controlled trial (RCT) and was it appropriately so	1	1	1
3. Were participants appropriately allocated to intervention and control groups? (5)	1.5/5	3.5/5	3/5
4. Were participants, staff and personnel blind to participants' study group? (2)	1/2	0.5/2	0.5/2
5. Were all the participants who entered the trial accounted for at its conclusion? (3)	2/3	3/3	3/3
6. Were the participants in all groups followed up and data collected in the same way? (1)	0.25/1	0.5/1	0.25/1
7. Did the study have enough participants to minimize the play of chance? (1)	0.5/1	0/1	0/1
8. How are the results presented and what is the main result? (2)	1/2	2/2	1.5/2
9. How precise are these results? (3)	1.5/3	1/2	1.5/3
10. Were all important outcomes considered so the results can be applied? (8)	7/8	3.5/4	6/8
TOTAL	14.75/25	14/21	15.75/25
TOTAL %	59%	67%	63%

3.3 Comparison of the two appraisal instruments used for RCTs

Table 4.7 compares the average (collective score) on the CASP system and on the PEDro Scale for the randomised controlled trials.

Table 4.7 Comparison between CASP and PEDro

(Randomised controlled trials)

Study	PEDro	CASP	Difference
Webb et al. (1985)	88%	64%	24%
Nicholas et al. (1999)	69%	50%	19%
Bohe et al. (2004)	81%	63%	18%

3.4 Summary of appraisal scores

Table 4.8 provides an overview of the scores of the studies in descending order.

Table 4.8 Summary of appraisal scores

Study	Score (AH)	Score (KMW)	Average
Perotta et al. 2008 (systematic review)	15/22 (CASP)	15/22 (CASP)	15/22 (68%)
Bohe et al. (2004) (Randomised controlled trial)	14.75/25 (CASP) 7/8 (PEDro)	14/21 (CASP) 6.5/8 (PEDro)	15.75/25 63% (CASP) 6.5/8 81% (PEDro)
Nicholas et al. (1999) (Randomised controlled trial)	13/25 (CASP) 6/8 (PEDro)	13.5/25 (CASP) 5/8 (PEDro)	12.2/25 50% (CASP) 5.5/8 69% (PEDro)
Beauvois (2001) (systematic review)	8.5/21 (CASP)	3.5 /21 (CASP)	6/21 (29%)
De Boeck et al. 2008 (systematic review)	7.5/22 (CASP)	4/22 (CASP)	5/22 (23%)

4. GRADING OF ARTICLES

Table 4.9 contains a summary of the grading results according to the Sackett hierarchy (2000), as described in Chapter 3 (Section 9). The grades are given in descending order.

Table 4.9 Grading of studies and level of evidence

Study	Grade	Level of evidence
Perotta et al. (2008)	A	1a
Nicholas et al. (1999)	A	1b
Bohe et al. (2004) (systematic review)	A	1b

All three of these studies can be graded as recommendation A, with a level of evidence of either 1a or 1b.

5. SUMMARY

Of the 10,016 study titles which were found during the initial search, only three were finally included. All three studies were of moderate to fair quality (CASP scores) ranging from 50 to 68 per cent.

The implications as well as the application of these results will be discussed in Chapter 5.

CHAPTER 5

Discussion, limitations, recommendations and conclusion

1. INTRODUCTION

In the previous chapter the findings of the study were given. This chapter starts with a summary of the findings and continues with an evaluation of the study. It concludes with implications for practice, management, policy, education and recommendations for research.

2. SUMMARY OF FINDINGS

This study aimed to determine the legitimacy of chest physiotherapy involving percussion, postural drainage and suctioning in non-ventilated paediatric patients with bronchiolitis from newborn to 24 months of age.

This review found that chest physiotherapy using percussion, postural drainage and suctioning should not be used *routinely* on patients with acute bronchiolitis, as such treatments have not been proved beneficial, and may even cause detriment by increasing stress and irritability, especially in the premature infant (Piedra et al., 2009). No standardised protocol for chest physiotherapy treatment should therefore be prescribed in paediatric patients with acute uncomplicated viral bronchiolitis unaccompanied by co-morbidities.

3. EVALUATION OF THE STUDY

3.1 Relevance

Many studies of the physiotherapy treatment of bronchiolitis were published in the 1970s and 1980s. Despite the fact that the incidence of bronchiolitis and bronchiolitis-related cases have increased, there has been little research in

recent years on the physiotherapy treatment of non-ventilated acute paediatric patients with bronchiolitis confirmed by Maher et al. (2008). Between 2004 and 2009, no new studies on chest physiotherapy treatment of paediatric bronchiolitis were published, as the present study produced the same results as Perotta et al. (2008). There is clearly a need for high quality research to augment the body of knowledge of physiotherapy in the field of respiratory paediatrics.

3.2 Strengths

3.2.1 Methods

The explicit methods used in systematic reviews in general and in this study in particular allow for the assimilation of available information which can be easily accessed by clinicians, researchers and policymakers (Greenhalgh, 1997). As the study used a predetermined protocol which included specific inclusion/exclusion criteria, bias was limited and the reliability and accuracy of the study was increased. Lack of time is a major obstacle for most clinicians and systematic reviews, like this one, are useful in that they make access to research synthesis and information easier and quicker. In this way, evidence-based clinical practice and research-based decision making can become a reality.

Synthesis of information might disguise or oversimplify important distinctions between individual studies regarding inclusion/exclusion criteria and the intervention itself (Porter, 2008) and this can be seen as a weakness of systematic reviews. In this study, this was compensated for by providing detailed results and referring specifically to individual studies rather than to global results only.

3.2.2 Inclusion of studies: All languages

In physiotherapy circles, researchers rely heavily on the PEDro database. The concern is, however, that studies published in other languages are significantly underrepresented. The reason could be that the majority of physiotherapy personnel at PEDro are fluent only in English (Moseley et al., 2002). The effect of this language bias is that “other language” studies cannot always be rated by PEDro assessors. In this systematic review a wider sample and higher quality was ensured by including all languages. Considering studies in languages such as Spanish and French, for instance, allowed the researcher to access information from non-English speaking European countries.

3.2.3 Inclusion of studies: Studies with a variety of designs

Systematic reviews and randomised controlled trials are highly ranked on the hierarchy of evidence. As this study investigated treatment and intervention in paediatric bronchiolitis, both systematic reviews and randomised controlled trials were mostly applicable. However, the researcher strove to add more understanding to the results by including all types of studies thus ensuring that grey literature and other study types such as qualitative studies were also considered. This approach differed from other systematic reviews found in the literature, where only randomised controlled trials were included.

Unfortunately, only systematic reviews and randomised controlled trials made it through the selection process in the end.

3.2.4 Number of databases

One of the strengths of this study is the fact that a large number of databases was searched in order to include as many studies as possible in the sample. In most systematic reviews found by the researcher, fewer than ten databases (between four and nine) were used to obtain articles/studies, compared to the 11 databases accessed in this study (Bessa-Nogueira et al., 2008; Perotta et al., 2008; Reilly et al. 2006; Smith et al., 2009; Smith, Dixon, Bowyer, Davies & Donell 2008; Warden et al., 2008; Verhagen et al., 2007).

3.3 Limitations

The limitations of the study as far as validity, reliability, methodology and outcomes measures are concerned are discussed in the following sections.

3.3.1 Validity and reliability

The researcher recommends that health-related searches and systematic reviews do not include the database Emerald, as it is not a medical database.

A third rater was not co-opted to assist in resolving scoring discrepancies between the two raters. Discrepancies were negotiated between these two raters and a consensus was reached.

A meta-analysis of the data used in the studies could not be done, as was confirmed by a statistician. One reason for this was that the researcher could not calculate effect sizes as standard deviations were not reported by Bohe et al. (2004). Also, the studies were heterogeneous regarding the following:

- Participants

Both studies had small sample sizes: Bohe et al. (2004) included 32 patient (66% male and 34% female), whereas Nicholas et al. (1999) used a sample of 50 patients (46% male and 54% female). Both samples had a mean age of 2.8 months.

Inclusion and exclusion criteria for patients varied between the two studies. In the study done by Bohe et al. (2004) all children with a clinical or viral diagnosis of acute bronchiolitis, admitted to the PICU were included, whilst Nicholas et al. (1999) included all patients with severe bronchiolitis who needed nasogastric tube feeding or intravenous fluids. For this reason participants could not be compared as different characteristics were reported.

- Interventions

Both Bohe et al. (2004) and Nicholas et al. (1999) used percussion, postural drainage and suctioning as techniques in their treatment groups. Nicholas et al. (1999), however, applied modified techniques where needed, i.e. responsive physiotherapy was administered.

Also in Bohe's study suctioning was done routinely, and in the case of Nicholas et al. (1999) suctioning was done only when indicated, and in combination with modified postural drainage positions (Bohe et al., 2004; Nicholas et al., 1999).

- Outcome measures

Nicholas et al. (1999) evaluated the effect of treatment by making use of the following outcomes measures: a change in clinical status according to a

clinical scoring system, length of hospital stay, provision of inspired oxygen and nasogastric feeding. Bohe et al. (2004), on the other hand, made use only of respiratory distress levels (clinical score) and the length of hospital stay to determine the effect of the interventions and to compare between the treatment and the control groups.

3.3.2 Limitations to the application in the South African setting

Bohe et al. (2004) conducted their clinical trial in Cordoba, southern Spain, whilst Nicholas et al. (1999) conducted theirs at the Royal Hospital for Sick Children in Edinburgh, Scotland. Although these countries are part of the developed world, and differ greatly from developing countries such as South Africa, the services rendered by these first world nations can certainly be rendered in the South African hospital and physiotherapy setting. However, resources such as qualified physiotherapists, pulmonologists and other specialists, as well as support structures such as laboratories to analyse sputum samples might not be available in all paediatric care settings, especially in rural areas. First class technology including tilting tables for postural drainage, neonatal percussors and radiology equipment, are limited in certain public hospital settings. However, what might present an added burden to the local South African bronchiolitis population are the co-morbidities and respiratory complications that are associated with HIV/AIDS. This may cause the population or sample of paediatric patients with bronchiolitis to present and react differently to treatment than children without these co-morbidities.

Despite advances in technology and medical care and the prevention of HIV and its associated opportunistic infections, the pandemic still rages almost unabated in developing countries and is the cause of high mortality rates in

children (Dashefsky, 1999; WHO, 2007). It is thus no surprise that opportunistic respiratory infections are commonly found in the paediatric population of South Africa, with RSV and para-influenza virus infections amongst the commonest in HIV-infected paediatric patients (Dashefsky, 1999). Care should thus be taken to not generalise bronchiolitis management, treatment and prevention strategies to patients living with HIV/AIDS, as the reaction to treatment might not be the same as in those children with a uncompromised immune system. Furthermore, it must be kept in mind that children with AIDS shed RSV for longer periods (Fischer et al., 2002) and this emphasises the fact that hand washing, hygiene and precautionary measures are even more important in this subset of patients.

3.3.3 Family, caregivers and the wider community

This study did not address the impact of bronchiolitis on the family, caregivers or the wider community.

3.3.4 Appraisal of this systematic review

The study scored an average of 70 per cent using the CASP appraisal instrument for systematic reviews. Although an overall score of 70 per cent implies a good standard, the overall score does not reflect specific weak elements in the methodological design. (Refer to the accompanying Compact Disc: “Appraisal of the dissertation” to view the various elements that scored low).

3.3.5 Conclusion

This study does contribute to the body of knowledge of physiotherapy in the field of paediatric respiratory treatment interventions, and it can add value to policies and guidelines, reflecting cost-effective, evidence-based practice.

The implications of the results for clinical practice, the professional body and policy makers are discussed in the following section.

3.4 Implications for clinical practice

The findings imply that no routine chest physiotherapy should be administered to paediatric patients suffering from acute bronchiolitis but who do not have underlying pathologies, co-morbidities or bacterial infections. Physiotherapy treatment to the chest should be based on a complete evaluation and on clinical merit, as well as on evidence and patient preference.

Clinicians would be assisted in their clinical decision-making processes by having these current evidence-based facts at hand in a single systematic review. Evidence-based practice should, however, not be based only on research, but should stand firmly on the three components of quality patient care: research, clinical expertise and patient preference.

The author however speculates that in cases where the infant experiences respiratory distress from blocked nasal passages or sinusitis, suctioning may be indicated if based on clinical evaluation, but not as routine treatment. Furthermore, responsive physiotherapy could reduce the level of respiratory distress in all infants and minimise the side effects of standardised chest physiotherapy.

Other techniques included in the scope of chest physiotherapy in European countries, such as passive exhalation techniques (including IEF), are potential alternative chest physiotherapy modalities that could provide greater benefit to the patient, without the side effects of routine, conventional chest physiotherapy in case of secretions or alveolar collapse. Although IEF requires highly skilled physiotherapists, it might be an alternative to conventional techniques of chest physiotherapy although not yet proved effective in the paediatric population. The application of techniques like IEF, once properly researched with randomised controlled trials could be a further paediatric respiratory adjunct that might be applied in the clinical setting in the near future.

3.5 Implications for the South African Society of Physiotherapy (SASP)

Findings from this study could be presented to the Paediatric Special Interest Group (SIG) of the SASP for incorporation in a paediatric respiratory guideline, as a complement to the existing adult guideline.

3.6 Clinicians, service managers and policy makers

Clinicians, specifically doctors and paediatricians, must be made aware of the evidence of these findings. The South African Medical Society (SAMA) should be informed that patients with acute viral bronchiolitis but with no other underlying pathologies or co-morbidities should not be referred for physiotherapy. However, patients with a secondary bacterial infection such as sinusitis or pneumonia, underlying pathologies and co-morbidities such as neurological conditions, heart defects and lung pathologies, as well as patients who are ventilated and admitted to ICU, might benefit from chest physiotherapy. Physiotherapists should apply treatment suitable to each individual patient. A manuscript for submission to the SAMJ has been prepared.

Elsewhere, complications did not increase despite non-referral for chest physiotherapy (Nicholas et al., 1999). Physiotherapy resources could therefore be better utilised in other conditions with proven benefit. In this way, cost and resource management would be improved.

As an alternative to these techniques, the holistic approach to treating paediatric patients with bronchiolitis could be considered. In a narrative letter about twins with bronchiolitis, a paediatric resident wrote the following: “I tried, succeeding on some days, and failing on others, to find some time to take with their exhausted mother, who was being worn away by the demands of her babies who were sick and the other kids at home who weren’t” (Moorehead, 2004). This suggests that education, support and a family-centred approach would be of benefit to these patients.

3.7 Recommendations for education

It is recommended that a summary of the findings be distributed to the eight universities that offer physiotherapy training in South Africa, to be incorporated in the education of physiotherapy students.

4. RECOMMENDATIONS FOR FUTURE RESEARCH

The researcher recommends that physiotherapy modalities other than percussion, postural drainage and suctioning be investigated. These modalities could include the empowerment of parents, family members and “the broader community” (the area, cultural background and society where the patient and his/her family live). Education of parents and caregivers plays an important role in the successful management of paediatric patients with bronchiolitis (Green, Zar, Jeena, Madhi & Lewis, 2010). Content of counselling

that could be investigated include hand washing practices, limiting sibling contact, breastfeeding (Fischer et al., 2002) and the limitation of exposure to

secondary tobacco smoke and smoke from indoor cooking, and other factors that might influence the incidence and severity of bronchiolitis (Couriel, 1999; Krilov, 2010; Steiner, 2004; Wainwright, 2010).

To improve the quality of future studies the following suggestions are made:

It is recommended that the following keywords be used in future studies (MeSH, 2010):

- Viral bronchiolitis
- Pulmonary postural drainage
- Respiratory bronchioles
- Respiratory drainage
- Respiratory Syncytial Virus infections
- Respiratory therapy
- Respiratory infections
- Respiratory tract Infections
- Physical therapy modalities
- Physical therapy techniques

The Embase database could be a possible database to include in future systematic reviews, especially for pharmacological interventions as the database focuses mainly on the use of medication.

An appraisal instrument that integrates relevant elements of both the PEDro scale and the CASP randomised controlled trial instrument should be developed and tested. The shortcomings of these two instruments could be minimised by addressing issues such as the absence of numerical scores for questions and the lack of guidance for the reviewer regarding certain concepts. To ensure validity and reliability of such an instrument the inter-rater and intra-rater reliability of such an instrument should be measured.

Furthermore, instruments specifically for physiotherapy studies need to be developed for studies with other designs than RCTs.

Individual chest physiotherapy techniques, such as suctioning, could be investigated in order to determine the specific effect(s) of these techniques, rather than investigating a cluster of techniques. As this study found, there appears to be no statistically significant difference between cluster treatment and the control groups. Thus the global effect, but not necessarily the contributing effect of individual modalities, was measured. Furthermore, the participants in some of the control groups in the reviewed studies received suctioning as well, and not just sham or placebo treatment. The absence of a statistically significant difference could therefore be explained by the fact that suctioning had a possible positive effect on clinical outcomes measures in the control group therefore lessening the difference between the experimental and control group.

The difference between risk factors for the development of bronchiolitis in developed countries and in developing countries like South Africa should be investigated. This would determine whether other factors specific to South Africa, such as HIV/AIDS and Tuberculosis (TB), contribute to the bronchiolitis risk profile and response to treatment.

5. CONCLUSION

This study provides evidence (Level A, grade 1a and b) that chest physiotherapy techniques including percussion, postural drainage and suction should not be used as rigid protocols or as routine standardised treatment. The physiotherapist should base the treatment plan on the individual patient's age, needs, preference and clinical response.

Physiotherapists do not always need to be “hands-on” during a treatment session, even though the SASP’s slogan is: “The difference is in our hands”. If hands-on techniques have not been proven successful, and may even be detrimental to the patient, the physiotherapists need to reconsider the role of the profession in paediatric bronchiolitis. Other avenues should be investigated: these could include improving quality of life, educating parents and caregivers on preventative measures such as hand washing and environmental hygiene, and on the dangers of secondary tobacco smoke. Primary health care and prevention should form part of the physiotherapist’s treatment regime.

In a country like South Africa where resources are scarce, it is useful to know that physiotherapists could be more effectively utilised in areas of proven effect, rather than being kept busy administering chest physiotherapy to patients with bronchiolitis when there is little evidence of its efficacy. By applying evidence-based physiotherapy in this field, practice costs may be reduced and resources can be distributed to areas of real need and where physiotherapists can make a positive difference.

List of references

AAP (American Academy of Pediatrics). Diagnosis and management of bronchiolitis, 2006. Subcommittee on Diagnosis and management of bronchiolitis. *Pediatrics*, 118, 1774-1793.

AARC (American Association for Respiratory Care) Clinical Practice Guideline. (2004). Nasotracheal suctioning-2004 Revision & Update. *Respiratory Care*, 49(9), 1080-1084.

Anderson, D.M., Keith, J., Novak, P.D., & Elliot, M.A. (2002). *Mosby's Medical, Nursing and Allied Health Dictionary*. (6th edn.). St Louis: Mosby.

Answers.com. (n.d.). *Respiratory therapy*. Retrieved Febr 17, 2010, from <http://www.answers.com/topic/respiratory-therapy>

Answers.com.(n.d.). *Publication bias*. Retrieved Nov 10, 2010, from <http://www.answers.com/topic/publication-bias>

Balachandran, A., Shivbalan, S., & Thangavelu, S. (2005). Chest physiotherapy in Pediatric Practice. *Indian Pediatrics*, 42, 559-568.

Barben, J., Kuehni, C.E., Trachsel, D., & Hammer, J. (2008). Management of acute bronchiolitis: can evidence based guidelines alter clinical practice? *Thorax*, 63, 1103-1109.

Bar-on, M.E., & Zanga, J.R. (1996). Bronchiolitis. *Journal of Primary Care*, 23(4), 805-819.

Baumer, J.H. (2007). SIGN guidelines on bronchiolitis in infants. *Archives Diseases Children Educational Practice*, 92(5), 149-151.

Beauvois, E. (2001). Place de la kinésithérapie dans le traitement des bronchiolitis aiguës du nourrisson. [Place of kinesitherapy in the treatment of acute bronchiolitis], *Archives de Pédiatrie*, 8(1), 128-131.

Bessa-Nogueira, R.V., Vasconcelos, B.C.E., & Niederman, R. (2008). *The methodological quality of systematic reviews comparing temporomandibular joint disorder surgical and non-surgical treatment*. Retrieved on October 28, 2010, from <http://www.biomedcentral.com/1472-6831/8/27>

Bhogal, S.K., Teasell, R.W., Foley, N.C., & Speechley, M.R. (2005). The PEDro scale provides a more comprehensive measure of methodological quality than the Jadad Scale in stroke rehabilitation literature. *Journal of Clinical Epidemiology*, 58, 668-673.

Bleakley, C.M. (2008). PEDro scores were based on information in the paper. *Australian Journal of Physiotherapy*, 54(4), 289.

Bohe, L., Ferrero, M.E., Cuestas, E., Polliotto, L., Genoff, M. (2004). Indicación de la fisioterapia respiratoria convencional en la bronquiolitis aguda. [Indications of conventional chest physiotherapy in acute bronchiolitis]. *Medicina (Buenos Aires)*, 64(3), 198-200.

Burns, N., & Grove, S.K. (2005). *The Practice of Nursing Research: Conduct, Critique and Utilization*. (5th edn.). Philadelphia: W B Saunders.

Calogero, C., & Sly, P.D. (2007). Acute viral bronchiolitis: To treat or not to treat-that is the question? (editorial). *Journal of Pediatrics*, 151(3), 235-237.

Campbell, S.K., van der Linden, D.W., & Palisano, R.J. (2006). *Physical Therapy for children*. (3rd edn.). St Louis: Saunders Elsevier.

- ChangingMinds.org. *Types of validity*. (2010). Retrieved June 17, 2010, from http://www.changingminds.org/explanations/research/design/types_validity.htm
- Chalumeau, M., Foix-L Helias, L., Scheinmann, P., Zuani, P., Gendrel, D., & Ducou-le-Pointe, H. (2002). Rib fractures after chest physiotherapy for bronchiolitis or pneumonia in infants. *Pediatric Radiology*, 32(9), 644-647.
- Ciesla, N.D. (1996). Chest physical therapy for patients in the Intensive Care Unit. *Physical Therapy*, 76(6), 609-625.
- Cincinnati Children's Hospital Medical Center. (2005). Bronchiolitis Guideline Team. *Evidence based clinical practice guideline for medical management of bronchiolitis in infants less than one year of age presenting with a first time episode*. Retrieved 4 Dec, 2009, from <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/bronchiolitis.htm>
- The Cochrane Collaboration open learning material. *Publication bias*. (2002) Retrieved June 14, 2010, from <http://www.cochrane-net.org/openlearning/HTML/mod15-2.htm>
- The Cochrane Musculoskeletal Group. *What is a systemic review?* (2010) Retrieved March 15, 2010, from <http://musculoskeletal.cochrane.org/what-systematic-review>
- Couriel, J. (1999). Non-asthma airway problems in children. *Medicine (UK Edition)*, 27(9), 49-53.
- Dakubo, G.B., & Commey, J.O. (1996). Acute respiratory infections in young children comparative findings in emergency rooms in Accra, (Ghana) and Harare (Zimbabwe). *West African Journal of Medicine*, 15(3), 181-185.
- Dashefsky, B. (1999). Pulmonary infections in children with HIV/AIDS. *Seminars in Pediatric Infectious Diseases*, 10(1), 60-71.

Dayan, P.S., Roskind, C.G., Levine, D.A., & Kuppermann, N. (2004). Controversies in the management of children with bronchiolitis. *Clinical Pediatric Emergency Medicine*, 5(1), 41-53.

De Boeck, K., Vermeulen, F., Vreys, M., Moens, M., & Proesmans, M. (2008). Airway clearance techniques to treat acute respiratory disorders in previously healthy children: where is the evidence? *European Journal of Pediatrics*, 167, 607–612.

Deschildre, A., Thumerelle, C., Bruno, B., Dubos, F., Santos, C., & Dumonceaux, A. (2000). Bronchiolite aigue du nourisson. [Acute bronchiolitis in infants]. *Archives de Pediatrie*, 7(Suppl. 1), 21S-26S.

DeVincenzo, J.P., Aitken, J.B., & Harrison, L.G. (2004). Opportunities for early therapy of respiratory syncytial virus (RSV infection): What happens before hospitalization? *Antiviral Research*, 62, 47-51.

DOH (Department of Health). *Paediatric Respiratory Medicine*. Retrieved March 15, 2007, from <http://www.doh.gov.za/search/index.html>

Domholdt, E., Flaherty, J.L., & Phillips, J.M. (1994). Critical Appraisal of Research Literature by Expert and Inexperienced Physical Therapy Researchers. *Physical Therapy*, 74(9), 853-860.

Evans, E.D., Kramer, S.S., & Kravitz, R.M. (1998). Pediatric diseases of the lower airways. *Seminars in Roëntgenology*, 33(2), 136-150.

Fazakerley, M. (2004). Clinical effectiveness of an integrated care pathway for infants with bronchiolitis. *Paediatric Nursing*, 16(1), 30-35.

Field, M.J., & Lohr, K.N. (Eds.). (1990). *Clinical Practice Guidelines: Directions for a New Program*. Institute of Medicine, Washington DC: National Academy Press.

Fischer, G.B., Teper, A., & Colom, A.J. (2002). Acute viral bronchiolitis and its sequelae in developing countries. *Paediatric Respiratory Reviews*, 3(4), 298-302.

The Free Dictionary. (n.d.). Medical Dictionary. *Chest physiotherapy*
Retrieved Febr 17, 2010,
from <http://medical-dictionary.thefreedictionary.com/chest+physiotherapy>

The Free Dictionary (n.d.). Medical Dictionary. *Hierarchy of evidence*.
Retrieved June 14, 2010, from
<http://medical-dictionary.thefreedictionary.com/hierarchy+of+evidence>

The Free Dictionary (n.d.). Medical Dictionary. *Practice guidelines*.
Retrieved March 15, 2010, from
<http://medical-dictionary.thefreedictionary.com/practice+guidelines>

The Free Dictionary (n.d.). Medical Dictionary. *Systematic review*.
Retrieved March 15, 2010, from
<http://medical-dictionary.thefreedictionary.com/systematic+review>

Frownfelter, D.L. (1987). *Chest physical therapy and pulmonary rehabilitation: an interdisciplinary approach*. (2nd edn.). St Louis: Mosby.

Goldsmith, M.R., Bankhead, C.R., & Austoker, J. (2007). Synthesising quantitative and qualitative research in evidence-based patient information. *Journal of Epidemiology and Community Health*, 61, 262-270.

Green, R.J., Zar, H.J., Jeena, P.M., Madhi, S.A., & Lewis, H. (2010). South African guideline for the diagnosis, management and prevention of acute viral bronchiolitis in children. *South African Medical Journal*, 100(5), 320-325.

Greenhalgh, T. (1997). Papers that summarise other papers (systematic reviews and meta-analyses). *British Medical Journal*, 315(7109), 672-675.

Grimshaw J., McAuley, L.M., , Bero, L. A., Grilli, R., Oxman, A.D., Ramsay, C., Vale, L., & Zwarenstein, M. (2003). Systematic reviews of the effectiveness of quality improvement strategies and programmes. *Quality and safety in health care*, 12, 298-303.

Hek, G., Judd, M., & Moule, P. (2002). *Making Sense of Research: An Introduction for Health and Social Care Practitioner*. (2nd edn.). London: SAGE Publications.

Herbert, R., Jamvedt, G., Mead, J., & Hagen, K.B. (2005). *Practical Evidence-Based Physiotherapy*. Edinburgh: Elsevier.

Hodge, D., & Chetcuti, P.A.J. (2000). RSV: Management of the acute episode. *Paediatric Respiratory Reviews*, 1, 215-220.

Hudson, R.M., & Box, R.C. (2003). Neonatal respiratory therapy in the new millennium: does clinical practice reflect scientific evidence? *Australian Journal of Physiotherapy*, 49, 269-272.

Jeena, P.M. (2004). Role of respiratory Syncytial Virus in Bronchiolitis: current and future management options. *The Specialist Forum*, 4(7), 30-42.

Jeon, J.H., Merlyn, T. & Chenoweth, L. (2010). Leadership and management in the aged care sector: a narrative synthesis. *Australasian Journal on Ageing*, 29(2), 54-60.

Kercsmar, C.M. (2003). Current trends in neonatal and pediatric respiratory care: conference summary. *Respiratory Care*, 48(4), 459-464.

Krilov, L.R. (2010). *Respiratory Syncytial Virus (RSV) Infection*. Retrieved May 4, 2010, from <http://emedicine.medscape.com>

Lerou, P.H. (2001). Lower respiratory tract infections in children. *Current Opinion in Pediatrics*, 13(2), 200-206.

Le Souef, P. (1999). Asthma in children. *Medicine (UK Edition)*, 27(9), 54-57.

Macmillan, C. (1995). Nasopharyngeal suction study reveals knowledge deficit. *Nursing Times*, 91(50), 28-30.

Maher, C.G., Moseley, A.M., Sherrington, C., Elkins, M.R., & Herbert, R.D. (2008). A description of the trials, reviews, and practice guidelines indexed in the PEDro database. *Physical Therapy*, 88(9), 1068-1071.

Maher, C.G., Sherrington, C., Herbert, R.D., Moseley, A.M., & Elkins, M. (2003). Reliability of the PEDro scale for rating Quality of Randomized Control Trials. *Physical Therapy*, 83(8), 713-719.

Mansbach, J.M., & Camargo, C.A. (2009). Respiratory viruses in bronchiolitis and their link to recurrent wheezing and asthma. *Clinics in Laboratory Medicine*, 29(4), 741-755.

Maki, D.D. (2000). Pulmonary infections in HIV/AIDS. *Seminars in Roentgenology*, 35(2), 124-139.

Marechal, L., Barthod, C., Lottin, J., Gautier, G., & Jeulin, J.C. *Measurement system for gesture characterisation during chest physiotherapy act in newborn babies suffering from bronchiolitis*. In Proceedings of the 29th Annual International Conference of the IEEE EMBS, Cite Internationale, Aug 23-26, 2007 (pp. 5770-5773). Lyon, France.

Mariosalexandrou.com. *Scope creep definition*. (2010). Retrieved June 14, 2010, from <http://www.mariosalexandrou.com/definition/scope-creep.asp>

Martinón-Torres, F., Rodríguez Núñez, A., & Martinón Sánchez, J.M. (2001). La bronquiolitis aguda: evaluación de la terapia basada en la evidencia. [Acute bronchiolitis: evaluation of evidence-based therapy]. *Anales Espanoles de Pediatria*, 55(4), 345-54.

McIlwaine, M. (2006). Physiotherapy and airway clearance techniques and devices. *Paediatric Respiratory Reviews*, 7S, S220-S222.

McKenzie, K., Scott, D.A., Campbell M.A., & McClure, R.J. (2010). The use of narrative text for injury surveillance research: a systematic review. *Accident; Analysis and Prevention*, 42(2), 354-363.

MeSH (Medical Subject Headings). National Library of Medicine (2010). Retrieved October 30, 2010, from <http://www.nlm.nih.gov/mesh/MBrowser.html>

Mitra, P.K. (2007). *Handbook of Practical Chest Physiotherapy*. New Delhi India: Jaypee Brothers Medical Publishers.

Moorehead, P. (2004). My Twins. *Canadian Medical Association Journal*, 171(9), 1080.

Moseley, A.M., Herbert, R.D., Sherrington, C., & Maher, C.G. (2002). Evidence for physiotherapy practice: A survey of the Physiotherapy Evidence Database (PEDro). *Australian Journal of Physiotherapy*, 48, 43-49.

Mulrow, C.D. (1987). The medical review article: state of the science. *Annals of Internal Medicine*, 10,485-88.

NHS (National Health Service) Trust. Great Ormond Street Hospital for Children (2009). *Airway suction*. Retrieved March 1, 2010, from http://www.gosh.nhs.uk/clinical_information/clinical_guidelines/cpg_guideline_00034

Nicholas, K.J., Dhouieb, E.M.O., Marshall, T.G., Edmunds, A.T., & Grant, M.B. (1999). An evaluation of chest physiotherapy in the management of acute bronchiolitis: Changing clinical practice. *Physiotherapy*, 85(12), 669-674.

Opdekamp, C., & Sergysels, R. (2003). La kinésithérapie respiratoire dans les maladies pulmonaires. [Respiratory physiotherapy in lung diseases]. *Revue Medicale de Bruxelles*, 24(4), A231-235.

Paisley, S. (2010). *Filtering and evaluating the knowledge base*. Retrieved April 23, 2010, from <http://www.shef.ac.uk>

Panickar, J., & Eisenhut, M. (2008). Chest physiotherapy is not useful in bronchiolitis. *Emergency Medical Journal*, 25, 595-596.

Park, J.W., & Barnett, D.W. (2002). Respiratory Syncytial Virus Infection and the Primary Care Physician. *Southern Medical Journal*, 95(3), 353-357.

Patient UK. *Different levels of evidence*. Retrieved April 19, 2010, from [http://Patient UK, 2010/doctor/Different-Levels-of-Evidence-\(Critical-Reading\).htm](http://Patient%20UK,2010/doctor/Different-Levels-of-Evidence-(Critical-Reading).htm)

PEDro (Physiotherapy Evidence Database). *PEDro scale*. Retrieved Febr 17, 2010, from <http://www.pedro.org.au/english/downloads/pedro-scale>

Perotta, C., Ortiz, Z., & Roque, M. (2006). Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. *Cochrane Database of Systematic Reviews*, Issue 2.

Perotta, C., Ortiz, Z., & Roque, M. (2008). Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old (rev.). *Cochrane Database of Systematic Reviews*, Issue 4.

Petrisor, B.A., & Bhandari, M. (2007). The hierarchy of evidence: Levels and grades of recommendation. *Indian Journal of Orthopedics*, 41(1), 11-15.

PHRU (Public Health Resource Unit). (2007). *Critical Appraisal Skills Programme*. Retrieved September 23, 2006, from <http://www.phru.nhs.uk/casp/casp.htm>

Piedra, P.A., & Stark, A.R. (2009). *Treatment, outcome, and prevention of bronchiolitis in infants and children*. Retrieved April 23, 2009, from <http://www.uptodate.com>

Polak, M.J. (2004). Respiratory Syncytial Virus: overview, treatment and prevention strategies. *Newborn and Infant Nursing Reviews*, 4(1), 15-23.

Polgar, S., & Thomas, S.A. (2000). *Introduction to research in the health sciences*. (4th edn.). Edinburgh: Churchill Livingstone.

Porter, S. (2008). *First steps in research - a pocketbook for health care students*. Philadelphia: Churchill Livingstone.

Prasad, S.A., & Hussey, J. (Ed). (1995). *Paediatric Respiratory Care*. London: Chapman & Hall.

Pretorius, P.J., Catzel, P., Cronje, R.E., Findlay, G.H., & van Heerden, C. (1981). *Kindersiektes*. Goodwood: Nasou Beperk.

Pryor, J.A., & Prasad, S.A. (2002). *Physiotherapy for Respiratory and Cardiac problems: Adults and Paediatrics*. (3rd edn.). London: Churchill Livingstone.

Psarras, S., Papadopoulos, N.G., & Johnston, S. (2004). Pathogenesis of Respiratory Syncytial Virus bronchiolitis-related wheezing. *Paediatric Respiratory Reviews*, 5(1), 179-184.

Reilly, K.A., Barker, K.L., & Shamley, D. (2006). A systematic review of lateral wedge orthotics-how useful are they in the management of medial compartment osteoarthritis? *The Knee*, 13, 177 – 183.

Research Committee (Victorian Branch) of the APA and contributors (1999): Evidence-based practice. *Australian Journal of Physiotherapy*, 45(3), 167-171.

Rodriquez, W.J., Gruber, W.C., Welliver, R.C., Groothuis, J.R., Simoes, E.A.F., Meissner, H.C., Hemming, V.G., & Kramer, A.A. (1997). Respiratory Syncytial Virus (RSV) Immune globulin intravenous therapy for RSV lower respiratory tract infection in infants and young children at high risk for severe RSV infection. *Pediatrics*, 99(3), 454-461.

Sackett, D.L., Straus, S.E., Richardson, W.S., Rosenberg, W., & Haynes, R.B. (2000). *Evidence based medicine. How to practice and teach EBM*. (2nd edn.). Edinburgh: Churchill Livingstone.

Sannier, N., Bocquet, N., Timsit, S., Coccojaru, B., Wille, C., Garel, D., Boursiquot, C. & Cheron, G. (2001). Economic evaluation of the first episode of bronchiolitis. *Archives de Pediatrie*, 8(9), 922-928.

SASP (South African Society of Physiotherapy). Cardiopulmonary Rehabilitation Group. *Best practice guidelines for the use of manual chest clearance techniques* (2006).

Schulz, K.F., & Grimes, D.A. (2006). *The Lancet: Handbook of Essential Concepts in Clinical Research*. Edinburgh: Elsevier.

Shabana, Y., Long Ma, M.S., & Aderonke, O. (2008). Risk factors for admission in children with bronchiolitis from pediatric emergency department observation unit (EDOU). In American Academy of Pediatrics, Section on Emergency Medicine, Scientific Abstract presentation, AAP National Conference and Exhibition, 10 October, 2008 - Boston MA. Steven M Selbst, Guest editor. Published in *Pediatric Emergency Care*, 24(10).

Sherrington, C., Herbert, R.D., Maher, C.G., & Moseley, A. M. (2000). PEDro: A database of randomized trials and systematic reviews in physiotherapy. *Manual Therapy*, 5(4), 223-226.

SIGN (Scottish Intercollegiate Guidelines Network) (2006). Bronchiolitis in children: a national clinical guideline, 1-40. Retrieved 4 Dec, 2009, from <http://www.sign.ac.uk/pdf/sign91.pdf>

Sing, Y., & Govender, D. (2009). Infections in the HIV-infected child. *Diagnostic Histopathology*, 15(5), 251-263.

Smith, M., & Ball, V. (1998). *Cardiovascular/Respiratory Physiotherapy*. London: Mosby.

Smith, T.O., Davies, L., Donell, S.T. (2009). The reliability and validity of assessing medio-lateral patellar position: a systematic review. *Manual Therapy, 14*, 355–362.

Smith, T.O., Dixon, F., Bowyer, D., Davies, L., & Donell, T.S. (2008). EMG activity of vastus medialis and vastus lateralis with patellar instability: a systematic review. *Physical Therapy Reviews, 13*(6), 405-414.

Smyth, R.L & Openshaw, P.J.M. (2006). Bronchiolitis. *The Lancet, 368*, 312-322.

Social Research Methods. *Measurement Validity Types*. (2006). Retrieved June 17, 2010, from <http://www.socialresearchmethods.net/kb/measval.php>

Social Research Methods. *Reliability and Validity: What's the Difference?* (2006). Retrieved June 17, 2010, from <http://www.socialresearchmethods.net/tutorial/Colosi/lcolosi2.htm>

Sorce, L.R. (2009). Respiratory Syncytial Virus: From Primary Care to Critical Care. *Journal of Pediatric Health Care, 23*(2), 101-108.

Steiner, R.W.P. (2004). Treating acute bronchiolitis associated RSV. *American Family Physician, 69*(2), 325-330.

Taeusch, H.W., Christiansen, R.O., & Buescher, E.S. (1996). *Pediatric and Neonatal Tests and Procedures*. Philadelphia: Saunders.

Tercier, J.A. (1983). Bronchiolitis: a clinical review. *Journal of Emergency Medicine, 1*(2), 119-123.

Tooth, L., Bennett, S., McCluskey, A., Hoffman, T., McKenna, K., & Lovarini, M. (2005). Appraising the quality of randomized controlled trials: inter-rater reliability for the OTseeker evidence database. *Journal of Evaluation in Clinical Practice*, 11(6), 547-555.

Turkelson, C., & Hughes J.E. (2006). The role of systematic reviews in evidence-based practice. *American Academy of Orthopaedic Surgeons*, 45(4), 1-5.

The University of Ottawa. Retrieved on November 6, 2010, from <http://www.biblio.uottawa.ca/content-page>

Verhagen, A.P., Karelis, C., Bierma-Zeinstra, S.M.A., Feleus, .A, Dahaghin, S., Burdorf, A., De Vet, H.C., & Koes, B.W. (2007). Ergonomic and physiotherapeutic interventions for treating work-related complaints of the arm, neck or shoulders in adults. A Cochrane systematic review. *Eura Medicophysica*, 43, 391-405.

Wainwright, C. (2010). Acute viral bronchiolitis in children - a very common condition with few therapeutic options. *Paediatric Respiratory Reviews*, 11(1), 39-45.

Warden, S.J., Hinman, R.S., Watson, M.A., Avin, K.G., Bialocerkowski, A.E., & Crossley, K.M. (2008). Patellar Taping and Bracing for the Treatment of Chronic Knee Pain: A Systematic Review and Meta-Analysis. *Arthritis & Rheumatism (Arthritis Care & Research)*, 59(1), 73–83.

Webb, M.S., Martin, J.A., & Cartlidge, P.H., Ng, Y.K., & Wright, N.A. (1985). Chest physiotherapy in acute Bronchiolitis. *Archives of Disease in Childhood*, 60, 1078-1079.

Webb, M.S.C., & Reynolds, L.J. (1996). Management of acute bronchiolitis. *Current Pediatrics*, 6, 252-256.

Welliver, R.C. (2004). Respiratory syncytial virus infection: therapy and prevention. *Paediatric Respiratory Reviews*, 5(Suppl. A), S127-S133.

WHO (World Health Organization). *HIV/AIDS*. (2007). Retrieved on September 29, 2007, from http://www.who.int/topics/hiv_aids

Willis, K.C. (2007). Bronchiolitis: Advanced Practice Focus in the Emergency Department. *Journal of Emergency Nursing*, 33(4), 346-351.

Zorc, J.J., & Phelan, K.J. (2008). What's new for seasonal wheezing (CME) An update on the AAP's bronchiolitis guidelines and the latest evidence on assessment and treatment. *Contemporary Pediatrics*, 25(2), 54-62.

Shortened bibliography

AARC (American Association for Respiratory Care). Clinical Practice Guideline. *Definition of respiratory care*. Position paper. Retrieved February 17, 2010, from:

http://www.aarc.org/resources/position_statements/defin.html

Adams, M., & Doull, I. (2009). Management of bronchiolitis. *Paediatrics and Child Health*, 19(6), 266-270.

Anderson, D.M. (2003). *Dorland's Illustrated Medical Dictionary*. (30th edn.). Philadelphia: Saunders.

Babl, F.E., Sheriff, N., Neutze, J., Borland, M., & Oakley, E. (2008). Bronchiolitis management in pediatric emergency departments in Australia and New Zealand. A Predict study. *Pediatric Emergency Care*, 24(10), 656-658.

Barke, M., & Eales, C.J. (1994). Ambubagging as a therapeutic technique: clinical guidelines. *Fisioterapie*, 50(2), 26-27.

Barr, F.E., & Graham, B.S. *Treatment and prevention of respiratory syncytial virus infection*. Retrieved on October, 2009, from <http://www.uptodate.co.za>.

Belperio, J.A., Lake, K., Tazelaar, H., Keane, M.P., Strieter, R.M., & Lynch, J.P. (2003). Bronchiolitis Obliterans Syndrome Complicating Lung or Heart-Lung Transplantation. *Seminars in Respiratory Critical Care Medicine*, 24(5), 499-530.

Bezruchenko, S.V. (2002). Распылитель терапии с точки физиотерапевт зрения. [Nebulizer therapy from the physical therapist's point of view]. *Voprosy Kurortologii, Fizioterapii i Lechebnoi Fizicheskoi Kultury*, 1, 10-12.

Bourrillon, A. (2007). Bronchiolite aiguë chez les nourrissons. [Acute bronchiolitis in infants]. *La Revue Du Praticien*, 57(17), 1902-8.

Chetcutti, P.A.J., & Crabbe, D.C.G. (2006). Non-asthma airway problems. *Medicine*, 31(12), 56-58.

Choi, B.C.K., & Noseworthy, A.L. (1992). Classification, Direction, and Prevention of Bias in Epidemiologic Research. *Journal of Medicine*, 34(3), 265-271.

Concato, J., Shah, N., & Horwitz, R.I. (2000). Randomized, controlled trials, observational studies, and the hierarchy of research designs. *New England Journal of Medicine*, 342(25), 1887-1892.

Coovadia, H.M., & Loening, W.E.K. (1992). *Paediatrics and Child health: a handbook for health professionals in the 3rd world*. Cape Town: Oxford University Press.

Corsello, G. (2007). Bronchiolitis: The New American Academy of Pediatrics Guidelines. *Journal of Chemotherapy*, 19(2), 12-14.

Dutau, G., Juchet, A., Ritte, J.L., Ranee, F., Bremont, F., & Nouilhan, P. (1997). Aspects therapeutiques conflictuels au cours des bronchiolites aiguës du nourrisson. [Conflicting therapeutic aspects during acute bronchiolitis in infants]. *Archives de Pédiatrie*, 4(Suppl. 2), 72s-77s.

Ettensohn, D.B., Mayer, K.H., Kessimian, N., & Smith, P.S. (1988). Lymphocytic bronchiolitis associated with HIV infection. *Chest*, 93(1), 201-202.

Evans, E.D., Kramer, S.S., & Kravitz, R.M. (1998). Pediatric diseases of the lower airways. *Seminars in Roentgenology*, 33(2), 136-150.

Gameros Gardea, R.A. (1996). Thérapies par inhalation dans l'asthme. [Inhalation therapy in asthma]. *Revista Alergia Mexico*, 43(5), 109-115.

Gilbertson-White, S., Pappas, T.E., DaSilva, D.F., Tisler, C.J., & Gern, J.E. (2005). Rhinovirus illnesses during infancy predict subsequent childhood wheezing. *Journal of Allergy Clinical Immunology*, 116(3), 571-577.

Health 24. *SA emergency rooms to change*. Retrieved March 15, 2010, from http://www.health24.com/news/Trauma_First_aid_Injuries/1-952,36488.asp

Henning, E., Gravett, S., & van Rensburg, W. (2005). *Finding your way in academic writing*. (2nd edn.). Pretoria: Van Schaik Publishers.

Hoppin, A.G., Kim, M.S., TePas, E., Torchia, M.M., Wiley, J.F. *What's new in paediatrics*. Retrieved March 15, 2010, from http://www.uptodate.com/home/content/whatsNew.do?specialty=table_of_contents/13

Hough, A. (1996). *Physiotherapy in Respiratory care: a problem-solving approach to respiratory and cardiac management*. (2nd edn.). Oxford: Chapman & Hall.

Kattan, M., Platzker, A., Mellins, R.B., Schluchter, M.D., Chen, X.C., Peavy, H., Steinbach, S., Wohl, M.E., Hiatt, P., Hunter, J. & Colin A.A. (2001). Respiratory diseases in the first year of life in children born to HIV-1-infected women. *Pediatric Pulmonology*, 31(4), 267-76.

Kim, K., Phrampus, E., Sikes, K., Gracely, E., Corcoran, T., Saville, A., & Venkataraman, S. (2008). *Helium/oxygen improves clinical scores in treatment of children with bronchiolitis*. In American Academy of Pediatrics, Section on Emergency Medicine, Scientific Abstract presentation, AAP National Conference and Exhibition, 10 October 2008 (Session VII, no. 239). Boston.

King, V. J., Viswanathan, M., Bordley, C., Jackman, A.M., & Sutton, S.F. (2004). Therapy for paediatric bronchiolitis: scant supporting evidence. *InPharma Weekly*, 1(1427), 3.

Krost, W.S. (2004). Pediatric pulmonary emergencies. *Emergency Medical Services*, 33(1), 71-77.

Levin, M.J. (1994). Treatment and prevention options for respiratory syncytial virus infections. *The Journal of Pediatrics*, 124(Suppl. 5), S522-S527.

Marchac, V., Le Bourgeois, M., Scheinmann, P., & de Blic, J. (2002). The wheezy child from birth to three years, a therapeutic approach. *Revue Francaise d' Allergologie et d'Immunologie Clinique*, 42(3), 279-288.

Merck Medicus. *Disease modules of asthma*. Retrieved March 15, 2010, from <http://www.merckmedicus.com/pp/us/hcp/diseasemodules/asthma/default.jsp>

Morrow, B., & Argent, A.C. (2008). A comprehensive review of pediatric endotracheal suctioning: effects, indications and clinical practice. *Pediatric Critical Care Medicine*, 9(5), 465-477.

Morrow, B., Futter, M., & Argent, A. (2006). Effect of endotracheal suction on lung dynamics in mechanically ventilated paediatric patients. *Australian Journal of Physiotherapy*, 52, 121-125.

Morrow, B., Futter, M., & Argent, A. (2007). A recruitment manoeuvre performed after endotracheal suction does not increase dynamic compliance in ventilated paediatric patients: a randomised control trial. *Australian Journal of Physiotherapy*, 53, 163-169.

Oberwaldner, B. (2000). Physiotherapy for airway clearance in paediatrics. *European Respiratory Journal*, 15(6), 196-204.

Ogra, P.L. (2004). Respiratory syncytial virus: the virus, the disease and the immune response. *Paediatric Respiratory Reviews*, 5(Suppl. A), 119-126.

Pierre Robin glossary. Retrieved on February 17, 2010, from <http://www.pierrerobin.org>

Poletti, V., Casoni, G., Chilosi, M., & Zompatori, M. (2006). Diffuse panbronchiolitis. *European Respiratory Journal*, 28, 862-871.

Polit, D.F., & Beck, C.T. (2004). *Nursing Research: Principles & Methods*. (7th edn.). Philadelphia: Lippincott Williams & Wilkins.

Polit, D.F., & Beck, C.T. (2006). *Essentials of Nursing Research*. (6th edn.). Philadelphia: Lippincott Williams & Wilkins.

Quon, B.S., FitzGerald, J.M., Lemièrè, C., Shahidi, N., & Ducharme, F.M. (2010). Increased versus stable doses of inhaled corticosteroids for exacerbations of chronic asthma in adults and children. *Cochrane Database of Systematic Reviews*, Issue 10. Art. No.: CD007524. DOI: 10.1002/14651858.CD007524.pub2. Retrieved on October 28, 2010.

Ratliffe, K.T. (1998). *Clinical Pediatric Physical Therapy: A guide for the physical therapy team*. Philadelphia: Mosby.

Reijonen, T., Korppi, M., Kuikka, L., & Remes, K. (1996). Anti-inflammatory therapy reduces wheezing after bronchiolitis. *Archives of Pediatrics and Adolescent Medicine*, 150(5), 512-517.

Roussel, E. (1994). La kinesithérapie respiratoire. [Infantile acute bronchiolitis. Respiratory Kinesitherapy]. *Soins-Gynecologie, Obstetrique, Puericulture, Pédiatrie*, 155, 18-20.

Sackett, D.L. (1979). Bias in analytical research. *Journal of Chronic Disease*, 32, 51-63.

Sackett, D.L., Rosenberg, W.M., Gray, J.A., Haynes, R.B., & Richardson, W.S. (1996). Evidence based medicine: what it is and what it isn't. *Clinical Orthopaedics and Related Research*, 455, 3-5.

Scanlan, C.L., (Ed), Spearman, C.B. & Sheldon, R.L. (1995). *EGAN'S Fundamentals of Respiratory Care*. (6th edn.). St Louis: Mosby.

Sebban, S., Grimpel, E., & Bray, J. (2007). Prise en charge de la bronchiolite aiguë du nourrisson par les médecins libéraux du réseau bronchiolite Île-de-France pendant l'hiver 2003-2004. [Management of acute bronchiolitis in infants by general practitioners network bronchiolitis Ile de France during the winter of 2003-2004]. *Archives de Pédiatrie*, 14(5), 421-426.

Seiden, J.A., & Scarfone, R.J. (2009). Bronchiolitis: An evidence-based approach to management. *Clinical Pediatric Emergency Medicine*, 10, 75-81.

Slosberg, E.J., & Smith, C.G. (2007). The importance of disclaimers: distinction between optimal care and standard of care. *Pediatrics*, 120, 453-455.

Straus, S.E., Richardson, W.S., Glasziou, P., & Haynes, R.B. (2005). *Evidence-based medicine: How to practice and teach EBM*. (3rd edn.). London: Elsevier.

Swingler, G. H., Hussey, G. D., & Zwarenstein, M. (2000). Duration of illness in ambulatory children diagnosed with bronchiolitis. *Archives of Pediatrics & Adolescent Medicine*, 154, 997-1000.

Vasudevan, V.P., Mascarenhas, D.A., Klapper, P., & Lomvardias, S. (1990). Cytomegalovirus necrotizing bronchiolitis with HIV infection. *Chest*, 97(2), 483-484.

Wallis, C., & Prasad, A. (1999). Who needs chest physiotherapy? Moving from anecdote to evidence. *Archives of Disease in Childhood*, 80(4), 393-397.

Webster's New World College Dictionary. Retrieved on March 15, 2010 from <http://www.yourdictionary.com>

WHO (World Health Organization). *Chronic Obstructive Pulmonary Disease (COPD)*. Retrieved on October 28, 2010, from http://www.who.int/gard/news_events/World_Health_Statistics_2008/en/

Williams, G. T. (2000). Current issues in tropical paediatric infectious diseases: HIV infection in children in developing countries. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 94, 3-4.

Wing, A. (2006). "Why does he wheeze?" Wheezing and asthma in young children. Respiratory problems in childhood. *Journal of Family Health Care*, 16(3), 87-89.

Wood, B. P. (1999). What's the evidence? *Radiology (RSNA)*, 213(3), 635-637.