

# An analysis of articles on neonatal pain published from 1965 to 1999

Josep-Eladi Baños MD PhD<sup>1</sup>, Guido Ruiz B Pharm<sup>1</sup>, Elena Guardiola MD PhD<sup>1,2</sup>

**J-E Baños, G Ruiz, E Guardiola.**

**An analysis of articles on neonatal pain published from 1965 to 1999.**

**Pain Res Manage 2001;6(1):45-50.**

**OBJECTIVE:** To analyze articles on neonatal pain indexed in MEDLINE from 1965 to 1999.

**METHODS:** Papers published since 1965 and indexed in MEDLINE (*PubMed* <<http://www.ncbi.nlm.nih.gov>>) were considered. The search strategy was: 'pain' (MeSH terms) OR 'pain' (Title word) OR 'pain' (All Fields), AND 'infant, newborn' (MeSH terms). After the search was completed, a printed copy of the references was obtained, and each reference was reviewed to establish its pertinence to the study's objective. For each article, the year of publication, the journal of publication, the language of the journal, the country of the first author, the type of article and the subject were analyzed.

**RESULTS:** Only 545 of 2490 references identified by the MEDLINE search were considered to deal with neonatal pain. Few articles on neonatal pain were published from 1965 to 1985, but the number of articles published on this topic increased sharply after 1985. Most of the papers were published in English (84.6%). The United States, Canada and the United Kingdom were the main countries that published neonatal pain articles (38.6%, 14.2% and 13.3%, respectively). Clinical research articles (31.7%) were published most frequently; the main subjects of all the articles were pain related to colic (20.4%), general neonatal pain issues (13.6%) and procedural pain (13.4%). *Pediatrics* and *Archives of Diseases in Childhood* were the journals that published the most articles on neonatal pain (27 and 22, respectively).

**CONCLUSIONS:** Pain in neonates was a neglected subject of publication until the mid-1980s, and, currently, only a few countries seem interested in this type of pain. This lack of interest may be related to the undertreatment of pain in the neonatal period.

**Key Words:** *Bibliometrics; MEDLINE; Neonatal pain; Publications*

## Analyse des articles sur la douleur chez les nouveau-nés, publiés entre 1965 et 1999

**OBJECTIF :** Analyser les articles sur la douleur chez les nouveau-nés, indexés dans MEDLINE entre 1965 et 1999.

**MÉTHODE :** Ont été examinés tous les articles publiés depuis 1965 et indexés dans MEDLINE (*PubMed* <http://www.ncbi.nlm.nih.gov>). La recherche s'est faite en fonction des mots clés suivants : « douleur » selon le thésaurus MeSH, selon les mots dans le titre ou dans tous les champs ET « nourrisson », « nouveau-né » selon le thésaurus MeSH. Une fois la recherche terminée, nous avons imprimé la liste des références, puis passé en revue chacune d'elles pour établir leur pertinence par rapport à l'objectif de l'étude. Nous avons noté pour chacun des articles l'année de publication, le nom de la revue, la langue de publication, le pays du premier auteur, le type d'article et le sujet à l'étude.

**RÉSULTATS :** Sur les 2490 références relevées dans MEDLINE, 545 seulement portaient sur la douleur chez les nouveau-nés. Peu d'articles ont été publiés entre 1965 et 1985, mais le nombre de publications sur le sujet a enregistré une forte augmentation depuis 1985. La plupart des écrits étaient publiés en anglais (84,6 %) et ils provenaient surtout des États-Unis, du Canada et du Royaume-Uni (38,6 %, 14,2 % et 13,3 % respectivement). Il s'agissait le plus souvent d'articles en recherche clinique (31,7 %); les principaux sujets traités étaient les douleurs liées aux coliques (20,4 %), les problèmes relatifs à la douleur en général chez les nouveau-nés (13,6 %) et la douleur attribuable aux interventions (13,4 %). Ce sont *Pediatrics* et *Archives of Diseases in Childhood* qui ont publié le plus grand nombre d'articles sur la douleur chez les nouveau-nés (27 et 22 respectivement).

**CONCLUSION :** La douleur chez les nouveau-nés était un sujet de publication sans importance jusqu'au milieu des années 80, et actuellement seul un petit nombre de pays se montrent intéressés à ce type de douleur. L'insuffisance de moyens thérapeutiques pour soulager la douleur au cours de la période néonatale n'est peut-être pas étrangère au manque d'intérêt pour la chose.

<sup>1</sup>Department of Pharmacology and Therapeutics, School of Medicine, Universitat Autònoma de Barcelona, Bellaterra; <sup>2</sup>Unit of Medical Information and Documentation, QF Bayer, Barcelona, Spain

Correspondence and reprints: Dr Josep-E Baños, Department of Pharmacology and Therapeutics, School of Medicine, Universitat Autònoma de Barcelona, 08193-Bellaterra, Spain. Telephone +34-93-581-19-64, fax +34-93-581-29-86, e-mail [Josepeladi.banos@uab.es](mailto:Josepeladi.banos@uab.es)

Pediatric pain has been overlooked for many years. In his well known paper, Melzack (1) included pain in children in the category of needless pain, and ignorance and a lack of concern about this topic has been the rule for many years. Fortunately, the number of articles published in this field has increased in past years; however, few studies have analyzed the characteristics of these articles.

Bibliometric analyses help people to understand and to know how the interest of a specific area of science has developed over the years (2). However, such studies are scarce in the field of pain and have been published mainly in non-English journals (3-5). Bibliometric data relating to pediatric pain have been published even less frequently. After the classical reference to the small number of studies dealing with pediatric pain in the medical literature made by Eland and Anderson (6), only a short paper on this topic was published in the early 1990s (3). The review showed a progressive increase in articles dealing with pain in children, but only raw data were reported, and basic characteristics, such as languages, journals, subjects or countries, were not analyzed.

Of all the different types of pediatric pain, neonatal pain is most affected by erroneous beliefs and misunderstandings about the nociceptive physiology of children. As Schechter et al (7) pointed out, for many years, physicians and pediatricians largely accepted that pain pathways were not fully developed in the newborn. This assumption justified inhumane situations such as minor and even major surgery that was performed without full anesthetic coverage, the complete withdrawal of opioid analgesics to treat postoperative pain and the performance of painful medical procedures without any analgesic or anesthetic treatment. The situation started to change when studies clearly showed that nociceptive systems are fully developed in newborns (8), and that severe and dangerous consequences are related to the avoidance of full anesthesia in neonates (9).

The present study analyzed articles on neonatal pain that were published during the past 35 years (from 1965 to 1999, inclusively) to show the increasing interest in this area of research and medical care.

## METHODS

Papers published since 1965 and indexed in MEDLINE (*PubMed* <<http://www.ncbi.nlm.nih.gov>>) were considered. The search strategy was: 'pain' (MeSH terms) OR 'pain' (Title word) OR 'pain' (All Fields), AND 'infant, newborn' (MeSH terms). (The MEDLINE definition of the term 'infant, newborn' is an infant during the first month after birth.) The search was conducted on October 18, 1999; 2490 articles were retrieved and printed in MEDLINE format. The total list was reviewed by two of the authors who agreed about the articles that should be included in the analysis. Papers about pediatric pain in general and papers that were not directly related to the study of pain in newborns were withdrawn from the analysis.

The following data were analyzed for each article: the year of publication, the language of publication, the first author's address (country), the journal of publication, the subject

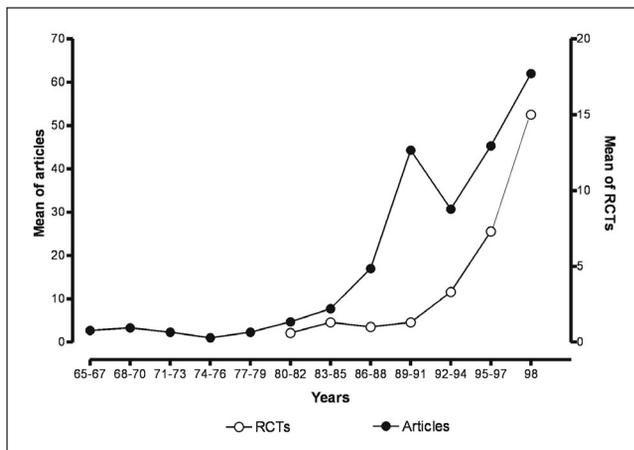
and the type of study or article. When information on one item was not included in a MEDLINE record, the item was categorized as 'unknown'. The year and language of publication were analyzed directly from MEDLINE data. The countries of authors were also recorded from MEDLINE data; when the addresses did not include countries, the countries were researched and, if found, added to the record by the authors of this study.

Articles were classified into 13 different subjects using the following classification that was developed by the authors.

- General (I): neonatal, newborn pain
- General (II): treatment, management
- Basic sciences: anatomy, physiology, pathophysiology, neurochemistry or psychology
- Pharmacology: local anesthetics, opioids, salicylates and nonsteroidal anti-inflammatory drugs (clinical trials on specific diseases were classified by disease)
- Specific pain (I): colic
- Specific pain (II): circumcision
- Specific pain (III): postoperative pain and surgery (anesthetic procedures were classified as 'anesthesia and anesthetic procedures')
- Specific pain (IV): medical and diagnostic procedures (immunizations [vaccinations], venepunctures, heel punctures, heel prick, heel lance, endotracheal tube passage or lumbar puncture)
- Specific pain (V): other painful events (pain in the neonatal intensive care unit, pain related to cholelithiasis, cancer, testicular torsion, intussusception, torticollis, burns or congenital neuropathy, and acute pain related to the scrotum, abdomen and the vulvulus)
- Pain evaluation and assessment
- Anesthesia and anesthetic procedures
- Knowledge, beliefs, attitudes, judgments, perceptions or hypotheses
- Other

Articles were classified into seven different categories.

- Nonoriginal research (I): reviews
- Nonoriginal research (II): opinion or position papers such as editorials, letters, comments, technical notes or discussions
- Original research (I): case reports and case report series



**Figure 1** Temporal evolution of articles and randomized clinical trials (RCTs) on neonatal pain (1965 to 1998). The figure shows the mean number of articles and RCTs of every three consecutive years. The last point on each curve corresponds to 1998 and represents only the absolute number of papers published in this year. Papers from 1999 are not represented because the indexing process of the database used was incomplete at the time the search was performed

- Original research (II): randomized clinical trials (RCTs)
- Original research (III): other clinical research studies such as surveys, nonrandomized studies or nonexperimental research
- Original research (IV): basic research involving animals and postmortem studies
- Unknown

Journals were also analyzed. A list of all the journals that published articles on pain in neonates was compiled, and the journals were grouped by area of medical knowledge. Nursing journals were considered to be a single group.

Data were analyzed by means of SPSS PC+ software (SPSS Inc, United States), and descriptive statistics were used to report the results.

## RESULTS

Five hundred forty-five (21.9%) of 2490 retrieved articles were included in the analysis because they dealt strictly with neonatal pain.

### Temporal evolution of articles

The number of articles on neonatal pain published per year ranged from zero (in 1977) or one (in 1965, 1974, 1975 and 1976) to 62 (in 1998). Most articles were published in 1998 (n=62), 1997 (n=50), 1989 (n=45), 1996 (n=44) and 1995 (n=42). Figure 1 summarizes the number of articles published from 1965 to 1998 (because data from 1999 were incomplete, that year is not included).

Two clearly separate periods in the publication of articles on neonatal pain may be identified. From 1965 to 1985, only a few papers on this topic were published per year, and the

**TABLE 1**  
Country of authors\* who published articles on neonatal pain from 1965 to 1999

Country	Total n=316 (%)
United States	122 (38.6)
Canada	45 (14.2)
United Kingdom	42 (13.3)
Sweden	21 (6.6)
France	16 (5.1)
Finland	11 (3.5)
Australia	9 (2.8)
Italy	8 (2.2)
Denmark	7 (2.5)
Germany	7 (2.2)
Other <sup>†</sup>	28 (8.9)

\*Only the address of the first author is included in MEDLINE. It was not included in 229 (44.3%) articles analyzed in this study; <sup>†</sup>Israel, the Netherlands and Norway (four articles each), and Spain and Switzerland (two articles each). Countries with only one paper indexed were Austria, Belgium, Brazil, Hungary, India, Japan, the former Soviet Union, South Africa, Turkey, Yugoslavia, Nigeria and Korea

number of published articles never exceeded 10 (the minimum number of articles published was zero in 1977 and the maximum number of articles published was nine in 1983). During this period, there was a gradual increase in published articles after 1977; during the first years of this period, fewer than five articles per year were published, whereas in the early 1980s, an increasing number of papers appeared. In the second period, from 1985 to 1998, a sharp increase in articles was seen; while 28 articles were published in 1987, this figure rose steadily to reach a maximum of 62 articles in 1998.

When cumulative percentages were analyzed, the results showed that more than one-half (53.2%) of the articles were published during the last seven years (from 1993 to 1999) in contrast with the first 20 years (from 1965 to 1984) when only 12% of the papers were published.

### Language of publication

Articles on neonatal pain were published in 14 different languages. The majority of articles (n=461, 84.6%) were published in English, followed by French (n=20), German (n=16) and Swedish (n=11). The remaining articles were written in Danish (n=8), Norwegian (n=7), Italian (n=5), Czech (n=4), Dutch (n=3), Hebrew (n=3), Spanish (n=3), Serbo-Croatian (n=2), Finnish (n=1) and Russian (n=1).

### Country of authors

Authors from 27 countries published articles on neonatal pain (Table 1). Because MEDLINE did not include authors' addresses in 229 references, data from only 316 (58%) arti-

**TABLE 2**  
Types of articles dealing with neonatal pain published from 1965 to 1999

Type of article	Total articles n=545 (%)
Original research (III): Other clinical research studies	173 (31.7)
Nonoriginal research (II): Opinion or position papers	87 (16)
Nonoriginal research (I): Reviews	86 (15.8)
Original research (II): Randomized clinical trials	70 (12.8)
Original research (I): Case reports and case report series	12 (2.2)
Original research (IV): Basic research in animals and postmortem studies	3 (0.6)
Unknown	114 (20.9)

**TABLE 3**  
Distribution of articles on neonatal pain published from 1965 to 1999 by subject

Subject	Total articles n=545 (%)
Specific pain (I): Colic	111 (20.4)
General (I): Neonatal, newborn pain	74 (13.6)
Specific pain (IV): Medical and diagnostic procedures	73 (13.4)
Specific pain (II): Circumcision	53 (9.7)
Specific pain (V): Other painful events	49 (9)
Pain evaluation and assessment	47 (8.6)
General (II): Treatment, management	40 (7.3)
Specific pain (III): Postoperative pain and surgery	36 (6.6)
Pharmacology	19 (3.5)
Basic sciences	15 (2.8)
Anesthesia and anesthetic procedures	13 (2.4)
Knowledge, beliefs, attitudes, judgments, perceptions or hypotheses	11 (2)
Other	4 (0.7)

cles were analyzed. The United States published 122 (38.6%) articles, followed by Canada (n=45, 14.2%), United Kingdom (n=42, 13.3%), Sweden (n=21, 6.6%), France (n=16, 5.1%) and Finland (n=11, 3.5%). Most of articles were from North America (n=167, 52.8%) and Europe (n=130, 41.1%). Articles from other continents were scarce: eight from Australia, eight from Asia, two from Africa and one from South America. English-speaking countries (the United States, Canada, the United Kingdom, Australia and South Africa) published 218 (69%) papers, and Scandinavian countries (Sweden, Norway, Denmark and Finland) published 43 (13.6%) articles.

#### Type of article

Table 2 summarizes the different types of neonatal pain articles that have been published. Nonexperimental clinical research was the type of article published most frequently, followed by nonoriginal research articles (opinion papers

**TABLE 4**  
Journals that published articles on neonatal pain from 1965 to 1999

Journal (only if n≥10 articles)	Number of articles
<i>Pediatrics</i>	27
<i>Archives of Diseases in Childhood</i>	22
<i>Pain</i>	20
<i>The Lancet</i>	18
<i>Journal of Pediatrics</i>	17
<i>Acta Paediatrica</i>	14
<i>Neonatal Network</i>	14
<i>British Medical Journal</i>	11
Journal specialty (only if n≥5 papers)	Number of journals
Pediatrics (including perinatology)	53
Nursing (all specialties)	42
General and internal medicine	30
Gynecology and obstetrics	10
Anesthesia	9
Neurosciences (including neurology)	8
Pharmacology, pharmacy and therapeutics	6
Psychology and psychiatry	5

and review articles). By contrast, basic research was minimal. The temporal evolution of RCTs is shown in Figure 1. RCTs were almost nonexistent before 1985; the number of RCTs steadily increased after 1985, and followed a similar growth rate to that of the total publications in neonatal pain.

#### Subject

Articles on neonatal pain dealt with many different subjects (Table 3). Pain related to colic was the most frequent topic (n=111, 20.4%), followed by general aspects of neonatal pain (n=74, 13.6%), medical procedures (n=73, 13.4%) and circumcision (n=53, 9.7%).

#### Journals

Articles were published in a large number of journals (n=210); however, only eight journals published more than 10 papers. The journals that ranked first in terms of number of published papers were *Pediatrics* (n=27), *Archives of Diseases in Childhood*, including the *Fetal and Neonatal* edition (n=22), and *Pain* (n=20) (Table 4).

Based on specialty groupings, pediatric journals (n=53) published neonatal pain papers most frequently, followed by nursing publications (n=42).

## DISCUSSION

The present study shows that scientific interest in neonatal pain began recently, as is reflected by the articles that are indexed in MEDLINE. In fact, a very small number of papers on neonatal pain were published before 1987. Research in

this clinical field is, perhaps, one of the most recent areas of pain knowledge that has been explored recently.

More than one factor may explain why neonatal pain was an area of research that was forgotten by many physicians and researchers until recently. First, neonatal pain was considered to be nonexistent for many years, and only some papers that were published in the mid-1980s revealed that this belief was totally erroneous (10). As a consequence, the concept of immature nociceptive pathways in newborns was revisited, and neonatal pain began to be considered as an important area of research. A second reason may be the interest that perinatology aroused in many pediatricians in the 1980s, and the logical focus on pain in newborns as a clinical problem. However, to highlight one explanation over the other would involve speculation. Regardless, the result was an exponential growth in the number of articles on neonatal pain that were published after 1985, as the present review shows.

Our review suggests that interest in neonatal pain seems to be centred in Anglo-Saxon and Scandinavian countries. In fact, authors from the first group of countries published 69% of all papers, whereas articles from authors in the second group accounted for almost 14% of the papers. This finding is remarkable for two reasons. First, all European countries, excluding the Scandinavian countries and the United Kingdom, only contributed articles to the same level as that of Sweden, Finland, Norway and Denmark. One explanation for this finding is that countries with a high level of economic and scientific development largely contribute to biomedical papers (11). However, this may be true for some countries, but it is difficult to explain why Canada and Sweden, two countries with relatively small populations, have published more papers than France, Italy, Germany and Japan. We have no data to justify these findings, but we suggest that some countries are more sensitive to certain issues. This finding, however, should also be considered with caution; more than 40% of authors' addresses were unknown because MEDLINE did not include this information in the references. It is possible that non-English journals may not record addresses. Nonetheless, the analysis of the language of publication showed that only about 10% of papers were published in languages other than English and Scandinavian (Swedish, Danish, Norwegian and Finnish). In our opinion, these data reinforce the assumption that some countries are more interested in neonatal pain, and economic or scientific hypotheses cannot fully explain this finding.

Only a few articles dealt with data from RCTs; this was not an unexpected finding. Before the study was initiated, it was assumed that there would be a larger contribution of nonresearch papers (such as editorials or reviews); this presumption proved to be wrong because almost one-half of the papers reported data from experimental and nonexperimental research. This should be considered an optimistic trend in neonatal pain because research-based evidence may help to guide better management of neonatal pain. The subjects of the articles were diverse, and pain associated with colic was the topic most researched, especially in the first decades analyzed by our study. In recent years, an increasing number of

topics have been considered, and circumcision, pain evaluation and management, and postoperative pain should be regarded as being especially relevant to many researchers.

As expected, pediatric journals were the most interested in publishing papers on neonatal pain; *Pediatrics*, *Archives of Diseases in Childhood*, *Journal of Pediatrics* and *Acta Paediatrica* were among the journals that published the most articles. However, the contribution of pain specialty journals, such as *Pain*, and general medical journals, such as *The Lancet* or the *British Medical Journal*, should also be acknowledged. But the most remarkable finding with respect to journals is that there was a high number of journals in the nursing field that published articles on neonatal pain; as a specialty, only pediatric journals outnumbered the number of nursing journals that published neonatal pain articles. The important work of nurses in the study of pain in neonates, in particular, and in children, in general, is recognized from these data. The important contribution of nurses to the development of some areas, such as pain evaluation in children, is known by scientists who work in this field.

As a consequence of the increase in research activity on neonatal pain in the 1990s, some important facts, such as the feasibility of neonatal pain evaluation (12,13), the biological consequences of untreated pain in the newborns (14-16) and the ethical implications of providing inadequate analgesic therapy in the neonates (17-18), are now clearly established and accepted. Adequate pain treatment in this age group is increasingly recognized as a priority in neonate management (19-22).

## SUMMARY AND CONCLUSIONS

Neonatal pain has become an important area of research since the mid-1980s. That is the good news. The bad news is that there is a sparse contribution to this area of articles from large and important countries from the developed world. This lack of articles may reflect a limited interest in treating neonatal pain; however, this statement should be supported by appropriate surveys. In this interconnected world, however, findings about the recognition of pain in newborns will reach every physician and nurse who is interested in the care of his or her youngest patients.

## REFERENCES

1. Melzack R. The tragedy of needless pain. *Sci Am* 1990;262:27-33.
2. Moed HF. The Use of Bibliometric Indicators for the Assessment of Research Performance in the Natural and Life Sciences. Aspects on Data Collection, Reliability, Validity and Applicability. Leiden: DSWO Press, 1989.
3. Guardiola E, Baños JE. Is there an increasing interest in pediatric pain? Analysis of the biomedical articles published in the eighties. *J Pain Symptom Manage* 1993;8:449-50.
4. Guardiola E, Baños JE. Difusión internacional de la investigación española en algología. Análisis del período 1981-1990. *Rev Esp Anestesiol Reanim* 1993;40:191-5.
5. Guardiola E, Baños JE. La publicación de libros sobre el dolor y su tratamiento en España. Análisis mediante la base de datos ISBN. *Rev Esp Anestesiol Reanim* 1995;42:119-24.
6. Eland JM, Anderson JE. The experience of pain in children. In: Jacox AK, ed. *Pain: A Source Book for Nurses and Other Health Professionals*. Boston: Little Brown, 1977:453-73.

7. Schechter NL, Berde CB, Yaster M. Pain in infants, children and adolescents: An overview. In: Schechter NL, Berde CB, Yaster M, eds. *Pain in Infants, Children and Adolescents*. Baltimore: William & Wilkins, 1993:3-10.
  8. Fitzgerald M, McIntosh N. Pain and analgesia in the newborn. *Arch Dis Child* 1989;64:441-3.
  9. Anand KJ, Hickey PR. Pain and its effects in the human neonate and fetus. *N Engl J Med* 1987;317:1321-9.
  10. Anand KJS. The biology of pain perception in newborn infants. In: Tyler DC, Krane EJ, eds. *Pediatric Pain: Advances in Pain Research and Therapy*, vol 15. New York: Raven Press, 1990:113-22.
  11. Guardiola E, Bosch F, Francesch J, Cobos A, Baños JE. Publications in pharmacology in the European Community: Their relationship with socio-economic indicators. In: Koenig MED, Bookstein A, eds. *Fifth International Conference of the International Society for Scientometrics and Informetrics. Proceedings*. Medford: Learned Information Inc, 1995:207-16.
  12. Jorgensen KM. Pain assessment and management in the newborn infant. *Perianesth Nurs* 1999;6:349-56.
  13. Abu-Saad HH, Bours GJ, Stevens B, Hamers JP. Assessment of pain in the neonate. *Semin Perinatol* 1998;22:402-16.
  14. Anand KJ. Effects of perinatal pain and stress. *Prog Brain Res* 2000;122:117-29.
  15. Anand KJ, Scalzo FM. Can adverse neonatal experiences alter brain development and subsequent behavior? *Biol Neonate* 2000;77:69-82.
  16. Anand KJ. Clinical importance of pain and stress in preterm neonate. *Biol Neonate* 1998;73:1-9.
  17. Franck LS. The ethical imperative to treat pain in infants: are we doing the best we can? *Crit Care Nurse* 1997;17:80-7.
  18. Yu VY. Ethical decision-making in newborn infants. *Acta Med Port* 1997;10:197-204.
  19. Franck LS, Lawhon G. Environmental and behavioral strategies to prevent and manage neonatal pain. *Semin Perinatol* 1998;22:434-43.
  20. Clemons RM. Issues in newborn care. *Prim Care* 2000;27:251-67.
  21. Furdon SA, Pfeil VC, Snow K. Operationalizing Donna Wong's principle of atraumatic care: pain management protocol in the NICU. *Pediatr Nurs* 1998;24:336-42.
  22. Menon G, Anand KJ, McIntosh N. Practical approach to analgesia and sedation in the neonatal intensive care unit. *Semin Perinatol* 1998;22:417-24.
-



**Hindawi**  
Submit your manuscripts at  
<http://www.hindawi.com>

