



# eLITERATURE REVIEW

## eNeonatal Review

Presented by the Johns Hopkins University School of Medicine and the Institute for Johns Hopkins Nursing

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### eNeonatal Review VOLUME 10, ISSUE 5

#### NEW PERSPECTIVES ON KANGAROO CARE

#### In this Issue...

Penetrating the high-tech atmosphere of the NICU with low-tech solutions like Kangaroo Mother Care (KMC) continues to challenge neonatal clinicians. However, a large and growing body of evidence supports KMC's safety, effectiveness, and potential for positive impact on important long-range outcomes, as well as its enthusiastic reception by families. Relatedly, the "triple aim" (Berwick et al, 2008) encourages professionals to achieve improvements in outcomes, experiences, and costs of care. The research reviewed in this issue establishes the impact of KMC on outcomes, experience by mothers and staff, and costs. Health care providers who embrace KMC, together with those who question it, can contribute equally by supporting translation of this evidence into practice and conducting robust, large-scale evaluation of KMC to ascertain if more widespread adoption moves toward the improved outcomes sought.



#### Program Information

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#### Length of Activity

- 1.0 hour Physicians
- 1.0 contact hour Nurses

#### Launch Date

March 26, 2015

#### Expiration Date

March 25, 2017

### LEARNING OBJECTIVES

After participating in this activity, the participant will demonstrate the ability to:

- Describe recent evidence that addresses concerns about the safety of Kangaroo Care (KC).
- Evaluate recent developments in the practice of Kangaroo Care (KC).
- Assess short-term and long-term outcomes associated with Kangaroo Care (KC).

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## COMMENTARY

Kangaroo Mother Care (KMC) has been practiced and studied globally for over four decades. Studies with full-term infants began in the 1970s in the USA<sup>1</sup> and were followed by preterm studies in Colombia, South America. Currently, the evidence base for KMC consists of nearly 1600 studies.<sup>2</sup> Rigorous experiments and metaanalyses provide compelling evidence of mainly positive effects of KMC. Important associated outcomes

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reported include increased physiologic stability,<sup>3,4</sup> decreased mortality,<sup>5,6</sup> increased warmth and prevention of hypothermia;<sup>7,8</sup> decreased apnea, irregular breathing, desaturations, and bradycardia, as well as improved heart rate variability;<sup>9,10</sup> decreased incidence of nosocomial infections;<sup>11</sup> and decreased pain perception.<sup>12,13</sup> Physiologic stability has been documented during interfacility transport in KMC.<sup>14</sup> These studies of the physiologic effects of KMC have included small (< 1000 gm), very preterm (< 28 weeks GA, ≤ 30 weeks postmenstrual age when studied)<sup>15,16</sup> and very sick infants, as well as more mature, older, and relatively stable preterm infants.<sup>17,18</sup>

The research reviewed in this issue corroborates earlier findings that the practice of KMC is safe and effective; supports ongoing efforts to adopt KMC as standard practice in the NICU; and contributes to the body of evidence which asserts that KMC improves outcomes for infants, mothers, and families, with impact that is immediate and sustained.

Adoption of low-tech intervention of KMC has challenged clinicians in NICUs globally. Its implementation in industrialized societies with greater resources has been slow, in part because of the value placed on high-tech and pharmacologic solutions, and in part because of concerns about risk and safety.

The first two studies reviewed address safety concerns. Carbasse et al, in a prospective observational study directed to the safety and efficacy of KMC, report on several positive short term physiologic effects accompanied by none of the undesirable outcomes of concern to careful clinicians. Further, they track various aspects of treatment and present findings that indicate KMC infants developed no additional demands for oxygen, medication, or other interventions. Hendricks-Munoz and Mayers describe an educational program for NICU staff accompanied by simulations to facilitate knowledge and enhance comfort with the practice of KMC. They introduced an approach to monitoring safety that can be useful for clinicians seeking to introduce KMC, and they report none of the negative events during KMC against which late adopters caution. This research team reports that a larger study is in progress.

As the practice of KMC is more broadly adopted and studied, its frequency and duration have been titrated to benefit babies and families. Recent evidence encourages clinicians to provide KMC not just at brief, broadly spaced intervals, but regularly and perhaps even continuously. Blomquist and Nygvist report on a single-facility pilot test of continuous KMC spanning the full hospitalization. They report high satisfaction but some fatigue among 23 mothers who remained skin to skin with their infants throughout the NICU stay. Although this was a small study with nonrandom selection, the authors also report no negative unintended consequences and introduce the potential and the challenge of the next wave of KMC practice.

The last two studies reviewed here address short-term outcomes and long-term impact. KMC was first introduced to the NICU, similarly to the introduction of some other interventions, slowly and with careful, comprehensive monitoring for risk and adverse events. KMC was offered to families thought to be good candidates and begun when each infant was considered sufficiently stable to tolerate the stress KMC might introduce and was limited in duration. Welch and colleagues studied KMC as part of a Family Nurture Intervention (FNI) beginning soon after birth, using EEG activity at 35 weeks and 40 weeks postmenstrual age. They document improved neural functioning associated with KMC as part of FNI. Finally, Feldman et al add to the evidence supporting the assertion that the

early practice of KMC has both short-term and long-term outcomes over a ten-year period. They document long-term benefits, including improved executive functioning, more adaptive stress response, and improved relationships between mother and child. As in other studies, this team reported no negative outcomes or long-term harm.

As the Institute of Medicine states, the progress from discovery (research) to application (practice) is complex, commonly spanning more than a decade.<sup>19</sup> Even by this standard, the neonatal community has been slow to adopt KMC. The article reviews presented in this issue complement the body of work already available on KMC. KMC is a simple, technology-sparing, family-supporting intervention that promises significant short-term gains and long-term impact. Clinicians are challenged to take action to support KMC implementation while carefully monitoring immediate outcomes and long-term impact. Concerns about safety can be mitigated by careful implementation plans and monitoring. The gains for infants, and benefits for mothers and families are powerful, compelling, and congruent with family-centered care.

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## SAFETY & EFFECTIVENESS OF SKIN-TO-SKIN CONTACT IN VULNERABLE PRETERM INFANTS

Carbasse A, Kracher S, Hausser et al. Safety and effectiveness of skin-to-skin contact in the NICU to support neurodevelopment in vulnerable preterm infants. *J Perinat Neonatal Nurs*. 2013;27(3):255-62.



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Carbasse and colleagues undertook this one-year prospective, observational study to evaluate the safety and effectiveness of early skin-to-skin contact (SSC) in very preterm newborns based on the recommendation of a 2010 Cochrane Database metaanalysis. The team observed 141 SSC sessions with 96 preterm infants at a level III NICU. Safety was defined as no occurrences of side effects such as accidental extubations or worsened clinical status, and effectiveness was defined as improvement in physiologic stability (vital signs, body temperature, and oxygen requirements). Eligible infants were born before 33 weeks gestation and clinically stable (even if intubated), which was operationally defined

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as:  $\text{FiO}_2 < 50\%$ , ventilator rate  $< 50/\text{min}$ , and no adverse respiratory events requiring medical interventions during the previous 12 hours. Exclusion criteria included severe respiratory distress ( $\text{FiO}_2 > 50\%$ ), persistent pulmonary hypertension (need for inhaled nitric oxide), intraventricular hemorrhage  $\geq$  grade 3, or severe sepsis.

SSC infants were diapered and held prone against the mother's chest. If an umbilical line was in place, the infant was placed obliquely on his/her side. Infants wore head caps and were covered by blankets. Transfers from incubator to the mother were mostly done while sitting. Physiologic parameters were recorded for each infant's first one to two SSC sessions at five time points: in the incubator 5 minutes before SSC; at 5, 30, and 60 minutes of SSC; 5 minutes before SSC ended; and 5 minutes after return to incubator. Repeated measures analysis of variance was conducted.

For the 96 newborns, the median gestation was 28 weeks (24-33 weeks), with median birth weight 1070 g (510-1972 g). SSC began at postnatal age of 0-55 days (median 12 days), with a mean postmenstrual age 30.5 (+/- 1.6) weeks. Most infants had central venous access (central venous catheter in 82 [85%], umbilical venous catheter in 10 [11%]). Seventeen infants (18%) were intubated, 49 infants (52%) were receiving nasal CPAP, and 30 infants (30%) were breathing room air.

Significant physiologic changes from baseline were observed during SSC. These included: increased oxygen saturation ( $P < .005$ ); decreased  $\text{FiO}_2$  requirement ( $P = .043$ ); and greater heart rate stability ( $P < .001$ ). During transfer into SSC, mean axillary temperature decreased moderately but transiently ( $P < .05$ ).

Safety and effectiveness of SSC was evaluated using a host of metrics. No significant differences were observed in temperature, HR, RR, or  $\text{SaO}_2$  between intubated and nonintubated infants. Significant increase in  $\text{TcPco}_2$  was observed among ventilated infants (+2.47, 95% CI +0.25 to +4.99) ( $P < .05$ ), but all values remained  $< 60$  mmHg during SSC (mean -5.36, 95% CI -3.4 to -7.4) ( $P < .001$ ). No extubations occurred. Apnea and bradycardia requiring minor intervention occurred in 19 (13%) SSC sessions but none required SSC termination. All changes, except transfer temperature loss, were independent of infant weight.

The researchers conclude SSC was safe and beneficial for clinically stable preterm infants, including those ventilated and those  $< 1000$  gm. These findings support the practice of SSC using evidence-based criteria. They propose that "earlier and longer" (practice of SSC) could improve neurodevelopment.

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## OVERCOMING BARRIERS TO ADOPTION OF KMC IN A NICU

Hendricks-Munoz KD, Mayers RM. A neonatal nurse training program in kangaroo mother care (KMC) decreases barriers to KMC utilization in the NICU. *Am J Perinatol*. 2014;31(11):987-992.



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Hendricks-Munoz and Mayers studied the impact of simulation training on knowledge, competence, and practice of Kangaroo Mother Care (KMC) in a tertiary care NICU in New York City.

Thirty-two NICU nurses participated in this prospective cohort study, which employed a pre-test post-test design. The study intervention involved a 7.5 hour educational program addressing the scientific basis for KMC, its impact on breastfeeding, and strategies to support families who want to practice KMC with their infant, as well as ways to evaluate parent and infant readiness to begin KMC. Didactic presentations by the medical staff were accompanied by high-fidelity manikin-based simulation activities centered on providing KMC care for infants in room air, on nasal cannula, on nasal continuous positive airway pressure (CPAP), and on synchronized inspiratory positive airway pressure (SIPAP), and those intubated and receiving conventional ventilation. During simulations, both apnea and bradycardia were introduced to challenge staff knowledge and performance. Debriefings by the trainer followed all simulations.

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Evaluation focused on nursing knowledge, comfort, competency, and practice of KMC. A competency checklist and knowledge assessment was conducted at baseline and again following the intervention.

Nurses' comfort with KMC increased in relation to all levels of demand for respiratory support. At baseline, 16.7% of the nurses reported feeling uncomfortable or unable to perform KMC, and discomfort increased as the level of respiratory support required by the infant increased. Discomfort increased to 67% when infants required NCPAP and 90% when ventilation was required. Similarly, 90% reported discomfort assisting in infant transfer to facilitate KMC.

Competency increased following education and simulation from 30% to 92% when KMC was practiced with intubation and ventilation ( $P < .0001$ ), and from 10% to 48% with CPAP ( $P < .004$ ).

Attitudes among nurses were influenced as well. Nurses who reported feeling uncomfortable with KMC decreased to 0%. They also reported greater clarity about their role implementing KMC and the increased value of encouraging parents to visit the NICU after the intervention was complete.

Behavior also changed. Actual practice of KMC with eligible infants increased from 26.5% at baseline to 85.9% after the training intervention ( $P < .0001$ ). KMC sessions were begun sooner: age at first KMC session decreased from 18 +/- 2.7 days at baseline to 5.6 +/- 1.2 days following the intervention. The KMC sessions also lasted longer, with a mean duration of 73.9 +/- 7.2 minutes at baseline and 203.6 +/- following the intervention.

These findings indicate that a training program presenting didactic information, accompanied by the opportunity to practice skills and debrief with experts, increased knowledge, confidence, and adoption of the evidence-based practice of KMC.

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## CONTINUOUS KANGAROO CARE FOR INFANTS DURING THEIR NICU STAY

Blomquist YT, Nygqvist KH. Swedish mothers' experience of continuous Kangaroo Mother Care. *J Clin Nurs*. 2011 May;20(9-10):1472-1480.



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A retrospective survey was conducted to determine experiences of the first group of mothers to provide 24/7 Kangaroo Mother Care (KMC) from the time of NICU admission until discharge in an affluent university NICU in Sweden. Selected sampling yielded 23 mother-infant pairs, including preterm infants and other infants in NICU, who experienced continuous KMC throughout hospitalization. Researchers conducted a retrospective chart review and mailed questionnaires to mothers as part of a pilot study that will extend to prospective research.

KMC was defined as early, prolonged and continuous skin-to-skin care of the infant with the mother, father, or a relative. The practice kept mother in the NICU where she was integral to care; where infants were exclusively breast milk fed and slept in KMC; where NICU nurses managed nursing care of the preterm; and post-partum nurses came to the mother to conduct assessments and provide her care. Infants wore only diaper, cap, and socks as they lay against the mother's chest continuously.

KMC infants were 31-41 weeks gestational age with birth weights ranging from 1715 to 3700 gm. The majority of the infants were male (70%), preterm (74%), and delivered vaginally (70%). Eight infants had been transported in KMC to the NICU. KMC was begun within one to four hours of birth. Three infants required intensive care immediately after birth and a few required minor surgeries (eg, hypospadias). One required ventilator support, three required CPAP, and 15 were treated for hyperbilirubinemia. Thirteen infants stayed in a family room from the first day of life. Discharge occurred between 33 and 42 weeks postmenstrual age after hospitalizations ranging between one to 33 days.

The questionnaire asked mothers to rank agreement with 24 statements about mother-infant contact, maternal stress, anxiety, fear about KMC, the role of nursing staff, and KMC itself throughout the hospital stay. One open-ended question invited mothers to provide comments about KMC.

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Seventeen of 23 mothers (74%) returned questionnaires, and 10 completed the open-ended question. All reported enjoyment in having close contact with their infants and none wanted to sleep at home and away from their infants during the hospitalization. Mothers reported feeling safe, stress-free, and without apprehension about providing KMC. Conversely, mothers reported in retrospect they needed more information to better understand the practice of truly continuous KMC, and they had not slept as well with the infant in continuous KMC, but they did not feel forced to stay at the bedside with their infants. Mothers found caring for their infant during the night to be exhausting. They sought clarification regarding the nurse's role, especially at night, during KMC. However, not one mother would have preferred not providing continuous KC, and none would have discontinued KC earlier.

The final open-ended question was analyzed using Graneheim and Lundman's qualitative content analysis. Mothers were overwhelmingly positive in their feedback. These pilot data indicate that mothers responding to the survey found continuous KMC to be more holistic, but they also wanted more practical information. KMC may be congruent with the goal to establish a connection and competence in new mothers of preterm and ill neonates.

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## SKIN-TO-SKIN CARE AND IMPROVED FRONTAL LOBE ACTIVITY

Welch MG, Myers MM, Grieve PG, et al; FNI Trial Group. Electroencephalographic activity of preterm infants is increased by Family Nurture Intervention; a randomized controlled trial in the NICU. *Clin Neurophysiol*. 2014 Apr;125(4):675-84.



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This randomized, controlled trial was conducted to determine the effect of the family nurture intervention (FNI) on frontal brain activity as measured by electroencephalographic (EEG) activity in preterm infants of 26-34 weeks GA in a Level IV NICU. EEG records from 134 infants during sleep at  $\approx$  35 and 40 weeks postmenstrual age (PMA) were obtained and analyzed.

FNI is designed to calm and reduce stress experienced by infant and mother. It begins during the interval between birth and the initiation of skin-to-skin care (SSC) and extends across the full length of the NICU stay. While the infant is incubator-bound, the mother places her hand on the infant's belly and talks to her infant about her emotions. She places one cotton cloth under her infant's head and another inside her bra. These cloths are exchanged one to two times daily because scent increases attachment and reciprocal regulation. When oxygen support is no longer needed and the infant can come out of the incubator, SSC begins. It lasts at least one hour daily for four or more days weekly. SSC calms infant and mother, and breastfeeding is encouraged. Family SSC, maternal/infant support measures, and conflict resolution approaches are taught to members of the FNI group. The standard care (control) group holds a swaddled infant, receives routine care, and remains uninformed of FNI.

EEG data were recorded at 1000 samples/sec using a 128-electrode net using 124 leads. Data were obtained within 30 minutes after a feeding between 11am and 4 pm. A 90-minute recording yielded 60 minutes of EEG data. Additionally, a 60-minute recording of high density EEG was obtained during sleep at 35 and 40 weeks of PMA. Spatially dependent measures of wave amplitude (power) at specific frequencies for 5 regions were calculated. Regional brain activity (power,  $\mu$ V<sup>2</sup>) was computed for 10 frequency bands between 1 and 48 Hz in each electrode. Multiple steps were taken to control for artifact and outliers. One hundred tests were conducted (10 frequency bands  $\times$  5 regions  $\times$  2 sleep states) to yield regional results corresponding to each week of development. A higher power indicates more brain activity, which predicts better neurobehavioral outcomes, as well as a lower likelihood of attention deficits, executive dysfunctions, depression, psychotic disorders, and autism spectrum disorder.

No significant differences between FNI and control groups with regard to parental demographic and maternal or infant birth or clinical conditions were found. FNI infants had fewer epochs identified as outliers in both Active Sleep and Quiet Sleep states than did controls at 35 weeks, and they had highly significant increases in regional power in all regions, with the most robust in the most frontal electrodes (the increased power was 19% to 36% greater in infants receiving FNI). FNI increased power across enrollment, in males and females, and in singletons and twins, and did so independent of age or weight at birth.

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As infants aged, left frontal power increased in those receiving FNI but not in controls; controls had decreased EEG power. The authors conclude that improvements are likely the result of learning (general and affiliative) from olfactory, temperature (SSC and holding provides warmth), and touch stimulation presented by FNI.

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## SHORT AND LONG-TERM IMPACT OF SKIN-TO-SKIN CARE

Feldman R, Rosenthal Z, Eidelman AI. Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. *Biol Psychiatry*. 2014;75(1):56-64.

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This team conducted a 10-year longitudinal study of 73 preterm infants (mean GA = 30.6 +/- 2.7 weeks, mean birth weight = 1270 +/- 343 gm) who received kangaroo care (KC) for at least one hour per day over 14 consecutive days (mean KC time 26.62 +/- 12.14 hours) starting at 32 weeks postmenstrual age, and 73 case-matched control infants who received routine, incubator-based care only. The study was conducted in two Level III hospitals. Researchers predicted that short-term gains from KC on infant neuromaturation and parental-infant bonding would lead to longer-lasting gains. They hypothesized that infants receiving KC would have better physiologic functions, maternal-child interactions, and cognition across childhood, with stability over time.

Infants were tested seven times over 10 years – at term; at 3, 6, 12, and 24 months; and at 5 and 10 years' age. At the close of the study, 117 children remained (62 KC; 55 controls). Infant autonomic functioning (respiratory sinus arrhythmia [RSA] as a sign of parasympathetic function) and sleep organization (behavior-based sleep cyclicality over four hours at term, or ActiGraph-based sleep over five nights in children) were measured at term and age 10 years, along with salivary cortisol reactivity. Parental mental health (depression, anxiety, and parenting stress) as well as maternal-infant interactions, were measured at term, 3 and 6 months (by videotape-based gaze, touch, and vocalization measures), and at 10 years by dyadic reciprocity constructs. Cognitive function was assessed using Bayley Scales of Infant Development (BSID-II) at 6, 12, and 24 months, then at 5 and 10 years, with intelligence quotient (Wechsler Preschool & Primary Scale of Intelligence) and executive functioning (NEPSY test).

Valid, standardized, age-appropriate, biological and psychological (IQ tests, Social Stress Test) indicators for each outcome were used, and observations and testing were conducted by trained psychologists blinded to group assignments. Statistical analyses accounted for confounding factors, and inferential test assumptions were met.

**As neonates:** KC infants showed higher baseline RSA ( $P = .008$ ), and more organized sleep/wake cycling ( $P = .009$ ). KC mothers had lower anxiety and stress and demonstrated more attachment behaviors than controls ( $P = .006$ ).

**At 3 and 6 months:** KC mothers had lower anxiety and stress than controls ( $P = .048$ ). KC infants had higher Bayley MDI scores, which persisted through 12 and 24 months ( $P = .000$ ).

**At 5 years:** KC infants had better executive function than controls ( $P = 0.046$ ).

**At 10 years:** KC infants had better neuropsychological ability, autonomic function, and sleep efficiency; marginally quicker recovery from stress; milder cortisol stress reactivity; and milder autonomic reactions to stress. KC mothers demonstrated greater reciprocity during interactions than controls ( $P = .017$ ).

Study limitations included lack of paternal-infant data, lack of true randomization, no full-term comparison group, and no data on effects of breastfeeding (although KC mothers expressed more breast milk than control mothers).

The authors conclude that KC is a low cost, post-partum intervention that targets contact-sensitive systems during a sensitive time period. They confirmed that early touch-based care has long-term benefits for child development.

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**Nurses**

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**LAUNCH DATE**

March 26, 2015; activities expire 2 years from the date of each publication.

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**STATEMENT OF NEED NUTRITION**

- Physicians may not be aware of recent evidence-based recommendations on recognizing and treating GERD in neonates.
- Physicians may not be aware of recent evidence-based recommendations on recognizing and treating GERD in neonates.
- Current neonatal nutritional management practices may be enhanced to optimize and meet the specific needs of low birth weight preterm infants.
- Current neonatal nutritional management practices may be enhanced to optimize and meet the specific needs of low birth weight preterm infants.
- Clinicians who treat neonates are uncertain of optimal strategies for prevention and early recognition and treatment of necrotizing enterocolitis.

**RESPIRATORY-RELATED ISSUES**

- Clinicians may be unfamiliar with some of the newest evidence-based approaches for treating neonatal persistent pulmonary hypertension.
- Clinicians treating preterm infants may not be fully aware of the most recent developments in optimal management of bronchopulmonary dysplasia and respiratory distress syndrome.

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Reviewed & Approved by: General Counsel, Johns Hopkins Medicine (4/1/03) (Updated 4/09 and 3/14)

**INTENDED AUDIENCE**

The target audience (clinicians) for this initiative includes neonatologists, respiratory therapists, neonatal nurses, nurse practitioners, and other members of the NICU team.

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and adverse effects before administering pharmacologic therapy to patients.

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**HARDWARE & SOFTWARE REQUIREMENTS**

To access activities, users will need:

- A computer with an internet connection
- An HTML5 compliant web browser or Internet Explorer 8 (and higher)

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This activity was developed in collaboration with DKBmed.

**COMPLETE THE POST-TEST**

**Step 1.**

Click on link to download instructions for the post-test and evaluation

**PHYSICIAN  
POST-TEST**

**NURSE  
POST-TEST**

**Respiratory Therapists**

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