

Asthma morbidity during pregnancy can be predicted by severity classification

Michael Schatz, MD, MS,^a Mitchell P. Dombrowski, MD,^b Robert Wise, MD,^c Elizabeth A. Thom, PhD,^d Mark Landon, MD,^e William Mabie, MD,^f Roger B. Newman, MD,^g John C. Hauth, MD,^h Marshall Lindheimer, MD,ⁱ Steven N. Caritis, MD,^j Kenneth J. Leveno, MD,^k Paul Meis, MD,^l Menachem Miodovnik, MD,^m Ronald J. Wapner, MD,ⁿ Richard H. Paul, MD,^o Michael W. Varner, MD,^p Mary Jo O'Sullivan, MD,^q Gary R. Thurnau, MD,^r Deborah Conway, MD,^s and Donald McNellis, MD,^t for the National Institute of Child Health and Development, Maternal-Fetal Medicine Units Network,* and the National Heart, Lung, and Blood Institute *San Diego and Los Angeles, Calif, Detroit, Mich, Baltimore and Bethesda, Md, Washington, DC, Columbus and Cincinnati, Ohio, Memphis, Tenn, Charleston, SC, Birmingham, Ala, Chicago, Ill, Pittsburgh and Philadelphia, Pa, Dallas and San Antonio, Tex, Winston-Salem, NC, Salt Lake City, Utah, Miami, Fla, and Oklahoma City, Okla*

Background: The 1993 National Asthma Education Program Working Group on Asthma and Pregnancy defined asthma severity as mild, moderate, or severe on the basis of symptoms

and spirometry, but no studies have evaluated the relationship between this classification system and subsequent asthma morbidity during pregnancy.

Objective: The objective of this study was to evaluate the relationship between asthma severity classification during pregnancy and gestational asthma exacerbations.

Methods: Asthma severity was defined according to the 1993 classification, adjusted to include medication requirements, in a volunteer sample of 1739 pregnant asthmatic patients who were less than 26 weeks' gestation.

Results: Initial asthma classification (mild, moderate, or severe) was significantly related to subsequent asthma morbidity during pregnancy (hospitalizations, unscheduled visits, corticosteroid requirements, and asthma symptoms during labor and delivery). Exacerbations during pregnancy occurred in 12.6% of patients initially classified as mild, 25.7% of patients classified as moderate, and 51.9% of patients classified as severe ($P < .001$). Asthma morbidity was similar, whether patients were classified as moderate or severe by symptoms and spirometry or by medication requirement. Thirty percent of initially mild patients were reclassified as moderate-severe during pregnancy, and 23% of the initially moderate-severe patients were reclassified as mild later in pregnancy; asthma morbidity in these patients changed accordingly.

Conclusion: The National Asthma Education Program Working Group on Asthma and Pregnancy classification of asthma severity, adapted to include medication use, predicts subsequent asthma morbidity during pregnancy. (*J Allergy Clin Immunol* 2003;112:283-8.)

Key words: Asthma, pregnancy, morbidity, severity

Asthma is one of the most common potentially serious medical complications of pregnancy. Approximately 4% of all pregnant women have a history of asthma, but up to 10% of the population appears to have nonspecific airway hyperresponsiveness.¹ In general, the prevalence, morbidity, and mortality from asthma are increasing.²

From the ^aDepartment of Allergy, Kaiser Permanente; ^bDepartment of Obstetrics and Gynecology, Wayne State University; ^cDepartment of Pulmonary Medicine, Johns Hopkins University; ^dBiostatistics Center, George Washington University; ^eDepartment of Obstetrics and Gynecology, the Ohio State University; ^fDepartment of Obstetrics and Gynecology, University of Tennessee; ^gDepartment of Obstetrics and Gynecology, Medical College of South Carolina; ^hDepartment of Obstetrics and Gynecology, University of Alabama; ⁱDepartment of Obstetrics and Gynecology, University of Chicago; ^jDepartment of Obstetrics and Gynecology, University of Pittsburgh-Magee Women's Hospital; ^kDepartment of Obstetrics and Gynecology, University of Texas Southwestern Medical Center; ^lDepartment of Obstetrics and Gynecology, Wake Forest University; ^mDepartment of Obstetrics and Gynecology, University of Cincinnati; ⁿDepartment of Obstetrics and Gynecology, Thomas Jefferson University; ^oDepartment of Obstetrics and Gynecology, University of Southern California; ^pDepartment of Obstetrics and Gynecology, University of Utah; ^qDepartment of Obstetrics and Gynecology, University of Miami; ^rDepartment of Obstetrics and Gynecology, University of Oklahoma; ^sDepartment of Obstetrics and Gynecology, University of Texas; and the ^tNational Institute of Child Health and Human Development.

Supported by grants from the National Institute of Child Health and Human Development (HD21410, HD21414, HD21434, HD27869, HD27917, HD27905, HD27889, HD27860, HD27861, HD27915, HD27883, HD34122, HD34116, HD34208, HD34136, HD19897) and the National Heart, Lung, and Blood Institute

Presented at the 56th Annual Meeting of the American Academy of Allergy, Asthma and Immunology, San Diego, Calif, April 2000.

*Participants in the Network of Maternal-Fetal Medicine Units are listed in Appendix 1.

Received for publication February 5, 2003; revised March 3, 2003; accepted for publication March 12, 2003.

Reprint requests: Michael Schatz, MD, MS, Chief, Department of Allergy, Kaiser-Permanente Medical Center, 7060 Clairemont Mesa Blvd, San Diego, CA 92111.

© 2003 Mosby, Inc. All rights reserved.

0091-6749/2003 \$30.00 + 0

doi:10.1067/mai.2003.1516

Abbreviations used

GINA: Global Initiative for Asthma
NAEPP: National Asthma Education and Prevention Program

In 1993, under the auspices of the National Asthma Education and Prevention Program (NAEPP) of the National Heart, Lung, and Blood Institute Division of Lung Diseases Prevention, Education, and Research Training Branch, a working group on asthma and pregnancy developed a statement regarding the treatment of asthma during pregnancy.¹ The working group defined mild, moderate, and severe asthma according to symptom and pulmonary function criteria. However, no studies have evaluated the relationship between this classification and subsequent asthma morbidity during pregnancy. In addition, this classification system was designed for untreated patients, and there are insufficient data as to how to classify patients who present during pregnancy already in treatment. Moreover, the consequences of a change in severity classification during pregnancy have not been explored.

The purpose of this study was to determine the risk of asthma exacerbation during pregnancy as a function of asthma severity determined by symptoms, pulmonary function, and need for medical therapy. The relationship of gestational asthma severity and morbidity to pregnancy outcomes will be reported separately.

METHODS

A prospective observational cohort study was conducted at 16 centers of the Maternal Fetal Medicine Units network during a period of 4 years with a target enrollment of 900 subjects with mild asthma and 900 subjects with moderate-severe asthma. Participants with mild asthma were matched for smoking status (any in the past week) with the non-mild cohort. Recruitment began in December 1994 and ended in March 1999. Case finding was by questioning all obstetric patients about having physician-diagnosed asthma. Informed written consent was obtained from all subjects, and the study was approved by each institution's local Institutional Review Board. Participants were excluded for known multiple gestation, intrauterine fetal demise, major congenital abnormalities, active pulmonary disease other than asthma, inability to schedule an ultrasound for gestational age confirmation, or gestational age greater than 25 weeks and 6 days at intake.

Spirometry (more than 4 hours after bronchodilator) was performed on all subjects at enrollment. Measurements of FEV₁ were made with the subject standing, after a maximal inspiration. To standardize spirometry techniques, all centers used Collins Stead-Well dry-seal volume displacement spirometers (Warren E. Collins, Inc, Braintree, Mass), and all research nurses underwent a training and quality review program.

The NAEPP working group on asthma and pregnancy¹ defined mild, moderate, and severe asthma according to symptoms and pulmonary function criteria in untreated patients. For the purposes of the current study, these definitions were adjusted to include daily medication use.

Subjects were considered to have mild asthma on enrollment if they had all of the following: (1) symptoms (cough, dyspnea, or wheezing) in the prior 6 months; (2) symptoms on fewer than 8 days during the 4 weeks before enrollment not attributable to upper res-

piratory tract infections; (3) an enrollment FEV₁ of 80% or greater predicted; and (4) were not taking daily asthma medications.

Subjects were considered to have moderate asthma on enrollment if they had any of the following: (1) symptoms on 8 or more days during the 4 weeks before enrollment not attributable to upper respiratory tract infections; (2) an enrollment FEV₁ 60% to 80% predicted; or (3) requirement for at least 1 daily asthma medication other than oral corticosteroids for at least the 4 weeks before enrollment, ie, daily inhaled β -agonist (at least 2 puffs per day), theophylline (at least 1 dose per day), inhaled ipratropium (at least 4 puffs per day), or at least 2 puffs per day of inhaled cromolyn, nedocromil, or inhaled steroids.

Subjects were considered to have severe asthma if either (1) their enrollment FEV₁ was less than 60% predicted or (2) they required regular (daily or every other day) oral corticosteroids for at least 4 weeks before entry.

An asthma exacerbation was defined as symptoms severe enough to result in a medical intervention, including hospitalization, unscheduled visits (physician or emergency department), or the prescription of oral corticosteroids (in patients who were not already on regular oral corticosteroids). Information on exacerbations after enrollment was collected prospectively and confirmed by review of medical records. The subject's history of asthma exacerbations during pregnancy before enrollment was collected retrospectively on enrollment in the study.

FEV₁ and information regarding symptom frequency, asthma medication use, and the occurrence of exacerbations were obtained on each monthly study visit. At the end of pregnancy, patients for whom at least 30 days of symptom data were available were reclassified as mild, moderate, or severe, applying the same criteria above to their postenrollment gestational course. During labor and delivery, asthma symptoms were noted to be present or absent.

The incidence of 1 or more asthma hospitalizations, unscheduled visits, or oral corticosteroid courses, as well as the proportion of patients with any exacerbation or symptoms during labor and delivery were analyzed as a function of asthma severity classification. Proportions were compared between severity groups by means of the Fisher exact test.

RESULTS

Between December 1994 and June 2000, 2562 pregnant asthmatic patients met the inclusion criteria for the study at the participating centers. Of these, 359 refused to participate, and 391 were not asked to participate (98 because they were outside the center's quota, 293 for uncertain reasons). The final enrolled cohort included 1812 patients, of whom 73 (4.0%) were lost to follow-up. Of the remaining 1739, asthma was classified as mild in 873 (50.2%), moderate in 814 (46.8%), and severe in 52 (3.0%). Demographic and baseline information and length of follow-up by initial severity group are presented in Table I.

No maternal deaths occurred. Four patients required intubation for asthma. Exacerbations during pregnancy and symptoms during labor and delivery as a function of asthma severity are shown for the period after enrollment in Table II. Patients with mild asthma experienced significantly fewer hospitalizations, unscheduled visits, oral steroid courses, and total exacerbations than patients with moderate asthma. Patients with moderate asthma experienced fewer hospitalizations, unscheduled visits, oral steroid courses, and total exacerbations than those with severe asthma. Regarding asthma symptoms during labor

TABLE I. Demographic and baseline information and duration of follow-up by initial severity group

Parameter	Mild (n = 873)	Moderate (n = 814)	Severe (n = 52)
Mean (± SEM) age (y)	22.3 (5.3)	24.0 (6.0)	25.8 (6.1)
Race (%)			
Black	59.1	51.0	72.7
White	30.6	38.1	20.0
Hispanic	9.2	8.8	7.3
Not married (%)	76.0	65.3	69.1
Mean (± SEM) years of school	11.7 (2.1)	11.7 (2.4)	11.7 (2.4)
Source of payment (%)			
Government assisted	80.7	78.4	87.3
Private	11.3	15.5	10.9
None	8.1	6.1	1.8
Smoking (%)			
Ever	46.8	46.9	38.2
Current	18.7	19.5	12.7
Mean (± SEM) prepregnancy weight (kg)	73.0 (21.9)	74.6 (22.6)	74.0 (20.2)
Mean (± SEM) weeks gestational age at enrollment	18.5 (4.9)	19.3 (4.8)	19.3 (4.8)
Mean (± SEM) weeks duration of follow-up	20.9 (5.5)	20.1 (5.4)	19.3 (6.0)

Asthma, rhinitis, other
respiratory diseases

TABLE II. Asthma morbidity during pregnancy after enrollment in the study in relationship to initial asthma severity classification

Asthma severity	Hospitalized for asthma	Unscheduled visit*	Oral corticosteroid for asthma	Exacerbation†	Asthma symptoms during labor/delivery
Mild (n = 873)	20 (2.3%)	99 (11.3%)	19 (2.2%)	110 (12.6%)	116 (13.3%)
Moderate (n = 814)	55 (6.8%), <i>P</i> < .0001‡	157 (19.3%), <i>P</i> < .0001	71 (8.7%), <i>P</i> < .0001	209 (25.7%), <i>P</i> < .0001	171 (21.0%), <i>P</i> < .0001
Severe (n = 52)	14 (26.9%), <i>P</i> < .0001	19 (36.5%), <i>P</i> = .003	20 (38.5%), <i>P</i> < .0001	27 (51.9%), <i>P</i> < .0001	24 (46.2%), <i>P</i> < .0001

*Includes unscheduled antenatal, primary care or emergency department visit for asthma.

†Hospitalization, unscheduled visit, or oral corticosteroid course for asthma.

‡*P* values indicate comparison to group directly above.

and delivery, patients with mild asthma were significantly less likely to experience symptoms than patients with moderate asthma, who were significantly less likely to experience symptoms than patients with severe asthma. The exacerbation data for the entire pregnancy (retrospectively at enrollment plus prospectively after enrollment) showed the same patterns as in Table II (data not shown).

The NAEPP Working Group on Asthma and Pregnancy asthma severity classification was meant for untreated patients. It was thus of interest to evaluate asthma morbidity in patients classified as moderate on the basis of symptoms and spirometry compared to patients classified as moderate on the basis of the need for daily medication (Table III). There were no significant differences between these groups regarding subsequent asthma hospitalizations, unscheduled visits, oral steroid requirements, or total exacerbations. Patients classified as moderate because of daily medication use were significantly less likely than patients classified as moderate on the basis of symptoms and spirometry to experience asthma symptoms during labor and delivery (*P* = .014). A simi-

lar analysis compared patients classified as severe by requiring regular oral corticosteroids to those classified as severe by pulmonary function criteria (Table III). No significant differences between groups were found regarding hospitalizations, unscheduled visits, total exacerbations, or asthma symptoms during labor and delivery.

There were 811 subjects with initially mild asthma who had sufficient follow-up data to warrant severity reclassification at the end of pregnancy. Of these, the asthma conditions of 565 (69.7%) remained mild, whereas the asthma conditions of 246 (30.3%) were reclassified as moderate or severe. There were 813 patients with asthma initially classified as moderate or severe who had sufficient follow-up data to warrant severity reclassification at the end of pregnancy. Of these, 627 (77.1%) remained unchanged, whereas the asthma conditions of 186 (22.9%) were reclassified as mild. The frequency of asthma hospitalizations, unscheduled visits, oral steroid use, any exacerbation, and symptoms during labor and delivery were significantly lower in subjects whose asthma condition remained mild throughout pregnancy (versus those whose

TABLE III. Asthma morbidity during pregnancy after enrollment in the study in relationship to initial asthma severity classification: Role of regular medications

Asthma severity	Hospitalized for asthma	Unscheduled visit*	Oral corticosteroid for asthma	Exacerbation†	Asthma symptoms during labor/delivery
Moderate—Medications‡ (n = 114)	7 (6.1%)	23 (20.2%)	11 (9.7%)	30 (26.3%)	14 (12.3%)
Moderate—Other§ (n = 700)	48 (6.9%)	134 (19.1%)	60 (8.6%)	179 (25.6%)	157 (22.4%)
P value: Moderate—Medications vs Other	.777	.795	.705	.866	.014
Severe—Steroids (n = 16)	5 (31.2%)	4 (25.0%)	11 (68.8%)¶	8 (50.0%)	8 (50.0%)
Severe—Other** (n = 36)	9 (25.0%)	15 (41.7%)	9 (25.0%)	19 (52.8%)	16 (44.4%)
P value: Severe—Steroids vs Other	.738	.249	.003	.853	.711

*Includes unscheduled antenatal, primary care, or emergency department visit for asthma.

†Hospitalization, unscheduled visit, or oral corticosteroid course for asthma.

‡Mild by symptoms and FEV₁ but on daily medications at enrollment.§Moderate by symptoms or FEV₁.||FEV₁ ≥ 60% but on regular oral corticosteroids at enrollment.

¶Regular oral corticosteroids were discontinued in 5 patients after enrollment.

FEV₁ < 60% at enrollment.TABLE IV.** Asthma morbidity for the entire pregnancy in relationship to the change in initial versus final asthma severity classification*

Initial/final asthma severity	Hospitalized for asthma	Unscheduled visit†	Oral steroid for asthma	Asthma exacerbation‡	Asthma symptoms during labor/delivery
Mild/mild (n = 565)	11 (2.0%)	75 (13.3%)	3 (0.5%)	80 (14.2%)	60 (10.6%)
Mild/moderate or severe (n = 246)	21 (8.5%), <i>P</i> < .0001§	83 (33.7%), <i>P</i> < .0001	20 (8.1%), <i>P</i> < .0001	92 (37.4%), <i>P</i> < .0001	45 (18.3%), <i>P</i> = .0028
Moderate or severe/moderate or severe (n = 627)	107 (17.1%)	264 (42.1%)	110 (17.5%)	310 (49.4%)	155 (24.7%)
Moderate or severe/mild (n = 186)	9 (4.8%), <i>P</i> < .0001	50 (26.9%), <i>P</i> = .0002	3 (1.6%), <i>P</i> < .0001	57 (30.7%), <i>P</i> < .0001	31 (16.8%), <i>P</i> = .0216

*Includes only patients with more than 30 days of follow-up data.

†Includes unscheduled antenatal, primary care, or emergency department visit for asthma symptoms.

‡Hospitalization, unscheduled visit, or oral corticosteroid course for asthma.

§*P* values indicate comparison to group directly above.

conditions were reclassified as moderate or severe) and in subjects with initially moderate or severe asthma whose conditions were reclassified as mild at the end of pregnancy (versus those who were not reclassified; Table IV).

DISCUSSION

In 1993, the NAEPP Working Group on Asthma and Pregnancy¹ used the 1991 NAEPP Expert Panel Guidelines³ to recommend a severity classification for asthma during pregnancy based on symptom frequency and pulmonary function.¹ However, no prior study has evaluated the relationship between this severity classification and subsequent asthma morbidity during pregnancy. Our data clearly demonstrate that the risk of asthma exacerbation during pregnancy is a function of asthma severity, as

defined by a classification based on the recommendations of the NAEPP Working Group on Asthma and Pregnancy in 1993. This classification should also be useful, not only for the care of individual pregnant asthmatic patients, but also for risk stratification for the purpose of managing populations of pregnant asthmatic patients.

One issue not addressed by prior asthma guidelines is how to classify patients who are already taking daily asthma medications. We found that the need for daily asthma medications per se was associated with outcomes similar to those of patients with moderate asthma severity, even though the patient would be considered to have only mild disease on the basis of symptoms and pulmonary function (Table III). This would suggest that pregnant asthmatic patients on daily asthma medications should be considered to have functionally moderate asth-

ma. Similarly, our data suggest that patients requiring regular oral corticosteroids should be classified as functionally severe.

Although the classification of asthma severity based on symptoms and pulmonary function tests in untreated patients has been recommended since 1991,³ we are aware of few data that have demonstrated a relationship between these NAEPP or Global Initiative for Asthma (GINA) severity classifications and asthma morbidity. Liard et al⁴ found a relationship between GINA-defined asthma severity and a history of asthma hospitalizations or emergency department visits, and Godard et al⁵ reported a relationship between NAEPP-defined asthma severity stage and subsequent cost of care. Moreover, although the most recent GINA guidelines⁶ recommend a method of classifying asthma severity in patients already on controller therapy, no validation of this approach has been published. The current data are the first to prospectively validate an NAEPP asthma severity classification in untreated and treated pregnant patients by showing a relationship to subsequent asthma morbidity. It remains to be determined whether these results will generalize to nonpregnant women or men. Although asthma severity can change during pregnancy, our data suggest that the severity classification and subsequent asthma morbidity change concurrently.

It is somewhat surprising that the patients whose condition would have been classified as mild (on the basis of symptoms and pulmonary function test results) but who were receiving daily medications had exacerbation rates similar to patients who were classified as having moderate asthma. Possible explanations for this include lack of adherence to prescribed daily medications, undertreatment in terms of doses or type of medication, or that the need for daily medication per se selects a group of women with particularly volatile asthma.

In 1997, the NAEPP published the Expert Panel Report II in which the definitions of asthma severity were modified to include mild persistent asthma.² On the basis of the new classification, our moderate patients would include patients with both mild persistent and moderate persistent asthma. Although one would hypothesize that patients with moderate persistent asthma would experience more asthma morbidity during pregnancy than patients with mild persistent asthma, this cannot be determined from the current data. With the current classification, our data do show that patients classified as having persistent (mild or moderate) asthma are at increased risk of gestational asthma morbidity compared to patients with intermittent (formerly classified as mild) asthma. As discussed below, differentiating mild from moderate persistent asthma in this population probably does not have substantial therapeutic implications.

This study also showed that approximately 30% of patients manifested an increasing severity classification during pregnancy, whereas approximately 23% noted a decreasing severity. This is consistent with prior data suggesting that asthma course worsens during pregnancy in approximately one third of women and improves in another third.⁷ As noted above, when the asthma severity classi-

fication changed during pregnancy, it was associated with a corresponding change in the risk of asthma morbidity.

The enrolled population was heavily weighted toward single mothers and enriched for blacks and those with subsidized insurance. This likely reflects the urban centers that make up the Maternal Fetal Medicine Units network. However, because asthma is more common and more severe in blacks⁸ and more severe in patients with lower socioeconomic status,^{9,10} this is an important population to study. Moreover, there is no particular reason to think that the severity classification validated in this study would not generalize to other populations with milder asthma.

In summary, the risk of an asthma exacerbation severe enough to require medical intervention during pregnancy is significantly related to asthma severity, classified on the basis of symptoms, pulmonary function, and medication requirement. Patients who changed severity classifications during pregnancy appeared to have a corresponding change in asthma morbidity prognosis. It would be hoped, but remains to be proved, that tailoring treatment on the basis of this severity classification would reduce the rate of asthma exacerbations during pregnancy.

We would like to acknowledge the support of James Kiley, National Heart, Lung, and Blood Institute.

REFERENCES

1. National Asthma Education Program Report of the Working Group on Asthma and Pregnancy. Management of asthma during pregnancy. Bethesda (MD): National Heart, Lung, and Blood Institute; 1993. NIH publication 93-3279A.
2. National Asthma Education and Prevention Program Expert Panel Report 2. Guidelines for the diagnosis and management of asthma. Bethesda (MD): National Heart, Lung, and Blood Institute; 1997. NIH publication 97-4051.
3. National Asthma Education Program Expert Panel Report. Guidelines for the diagnosis and management of asthma. Bethesda (MD): National Heart, Lung, and Blood Institute; 1991. NIH publication 91-3042.
4. Liard R, Leynaert B, Zureik M, Beguin F-X, Neukirch F. Using Global Initiative for Asthma guidelines to assess asthma severity in populations. *Eur Respir J* 2000;16:615-20.
5. Godard P, Chanet P, Siraudin L, Nicoloyannis N, Duru G. Costs of asthma are correlated with severity: a 1-year prospective study. *Eur Respir J* 2002;19:61-7.
6. Global Initiative for Asthma. Bethesda (MD): National Heart, Lung, and Blood Institute; 2002. NIH publication 02-3659.
7. Juniper EF, Newhouse MT. Effect of pregnancy on asthma: a critical appraisal of the literature. In: Schatz M, Zeiger RS, editors. *Asthma and allergy in pregnancy and early infancy*. New York: Marcel Dekker; 1993. p. 223-49.
8. Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. Surveillance for asthma: United States, 1980-1999. *MMWR* 2002;51:1-13.
9. Gottlieb DJ, Beiser AS, O'Connor GT. Poverty, race, and medication use are correlates of asthma hospitalization rates. *Chest* 1995;108:28-35.
10. Castro M, Schechtman KB, Halstead J, Bloomberg G. Risk factors for asthma morbidity and mortality in a large metropolitan city. *J Asthma* 2001;38:625-35.

APPENDIX 1

Institutions and staff members participating in the National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units were as follows: University of Pittsburgh Magee Women's Hospital: P. Heine, M. Cotroneo, E. Daugherty; University of Tennessee: B. Sibai, R. Ramsey; University of Southern California: Y. Rabello; University of Alabama at Birming-

ham: W. Andrews, R. Copper, S. Tate, A. Northen; Wayne State University: Y. Sorokin, G. S. Norman, A. Millinder; University of Cincinnati: T. A. Siddiqi, N. Elder, V. Pemberton; University of Oklahoma: J. C. Carey, A. Meyer; Wake Forest University: M. Harper, M. Melissa, A. Luper; University of Chicago: A. H. Moawad, P. Jones, M. E. Brown, G. Mallett; Ohio State University: J. D. Iams, F. Johnson, S. Meadows; Medical University of South Car-

olina: J. P. Van Dorsten, B. A. Collins; University of Miami: S. Beydoun, C. Alfonso, J. Potter, R. Washington, F. Doyle; University of Texas Southwestern: M. L. Sherman; University of Texas San Antonio: O. Langer, S. Barker; University of Utah: D. J. Dudley, L. Reynolds; Thomas Jefferson University: M. DiVito, C. Smith; George Washington University Biostatistics Center: V. Momirova, E. Rowland, S. Broncolini.

ON THE MOVE?

Send us your new address at least six weeks ahead

Don't miss a single issue of the journal! To ensure prompt service when you change your address, please photocopy and complete the form below.

Please send your change of address notification at least six weeks before your move to ensure continued service. We regret we cannot guarantee replacement of issues missed due to late notification.

JOURNAL TITLE:

Fill in the title of the journal here. _____

OLD ADDRESS:

Affix the address label from a recent issue of the journal here.

NEW ADDRESS:

Clearly print your new address here.

Name _____

Address _____

City/State/ZIP _____

COPY AND MAIL THIS FORM TO:

Mosby
Subscription Customer Service
6277 Sea Harbor Dr.
Orlando, FL 32887

OR FAX TO:

407-363-9661

M Mosby

OR PHONE:

800-654-2452
Outside the U.S., call
407-345-4000