Neonatal Mortality in Missouri Home Births, 1978–84

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Abstract: A study was conducted of 4,054 Missouri home births occurring from 1978 through 1984. Of the 3,645 births whose planning status was identified, 3,067 (84 per cent) were planned to be at home. Neonatal mortality was elevated for both planned (17 observed deaths vs 8.59 expected deaths) and unplanned home births (45 observed vs 33.19 expected) compared with physician-attended hospital births. Nearly all of the mortality excess for planned home births occurred in association with lesser trained attendants (12 observed vs 4.42 expected), while for unplanned home births the excess was entirely among infants weighing 1500 grams or more (19 observed vs 3.50 expected). For planned home births attended by physicians, certified nurse-midwives, or Missouri Midwife Association recognized midwives, there was little difference between observed and expected deaths (5 observed vs 3.92 expected). There also was little difference in deaths for unplanned home births weighing less than 1500 grams (26 observed vs 29.69 expected) compared with hospital births. The study provides evidence of the importance of having skilled attendants present at planned home births. (*Am J Public Health* 1987; 77:930–935.)

Introduction

Considerable controversy has been generated recently regarding the safety of home births.[1,2] Their advocates feel that home births with qualified attendants are safer than hospital births because fewer unnecessary intervention techniques are used. Opponents, however, feel that even in a low-risk pregnancy unpredictable complications of labor and delivery may occur that would require immediate medical attention in a hospital facility.

Scientific data are lacking that support either of these two divergent points of view. Burnett, *et al*,[3] in North Carolina and Hinds, *et al*,[4] in Kentucky both demonstrated the importance of controlling for the planning status of home births when examining their mortality. The neonatal death rate for unplanned home births was 18 to 20 times the death rate for planned home births in these two studies. For planned home births, no important difference was found in neonatal mortality compared with hospital births, but the numbers were small.

A second key variable that needs to be controlled in this type of study as demonstrated by Hinds[4] and Shy, *et al*,[5] is birth weight. Planned home births are usually uncomplicated, normal pregnancies with a low risk of mortality. If a mother goes into labor prematurely, arrangements are usually made to transfer the mother to a hospital before delivery, thereby deflating the low birth weight and mortality rate for planned home births.

A third key factor to consider is the training of the attendant at delivery. Burnett[3] found that planned home births attended by physicians or lay midwives had better outcomes than those attended by persons with less training. In Missouri, the legal status of midwives has come into question. In early 1986, the State Supreme Court ruled that lay midwives who accept funds for their services cannot practice midwifery in the state. There have also been investigations by the State Board of Nursing of registered nurses who are not certified as nurse midwives (CNM) but who practice midwifery. As a result of these actions, there is a movement in Missouri, as in other states, to pass legislation to register lay midwives. Whether these attendants have different outcomes than physician-attended hospital births is of primary importance to proponents and opponents of this movement.

Methods

All recorded home births occurring in Missouri during 1978–84 reported to the state Bureau of Vital Records by October 15, 1985 (4,146) served as the base for the study; results were compared to 525,645 Missouri resident physician-attended hospital births during the same time period. All infant deaths in the state are routinely matched to their corresponding birth records and put on a computer tape file. The neonatal deaths in this study were obtained from this matched infant death/birth file.

Definitions

A planned home birth was one that was intended to be at home with a healthy infant anticipated. The attendant was defined as the person who delivered the baby. Attendants included:

- Physician: MD or DO
- Certified nurse midwife (CNM): A registered nurse who has received graduate training in nurse midwifery and is certified by the American College of Nurse-Midwives
- MMA-recognized midwife: Lay or nurse midwife who is either a member of the Missouri Midwives Association (MMA) or has been recognized as meeting the minimum standards of MMA[6]
- Non-MMA midwife: Religious midwives, those who identified themselves as midwives on birth certificates or who were identified by other sources in the study as midwives but were not recognized by MMA
- Other: Primarily fathers, but also paramedics, chiropractors, friends of family or anyone else not identified above

Survey Design

To obtain planning status, accurate attendant type at delivery, and verification of home birth, we sought information from various sources about specific home births they might know about. Each source was sent a short survey requesting information about each birth. The sources are as follows:

- *County Health Nurses*—Listings of home births within each of 115 counties were sent to the county health departments by the State Department of Health. Home birth certificates signed by CNMs or two physicians known to do large numbers of planned home births were excluded from these listings but deaths were not excluded. Through avail-

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TABLE 1—Survey Response Rates by Source

Source	Number of Sources		Per Cent Responded	Number of Birth Surveys		Per Cent Returned
	Contacted	Responded		Sent	Returned	
County Health Departments	115	106	92	2,812	899	32
Missouri Midwives Association	50	47	94	2,812	734	26
Physicians	429	317	74	2,008	1,550	77
Certified Nurse Midwives	5	5	100	206	202	98
Hospitals	37	34	92	133	82	62
Parents	1,261	500	40	1,438	571	40
Total	1,897	1,009	53	4,146*	3,345*	81

*Total from one or more sources.

able resources (prenatal clinics, child health conferences, general knowledge), the nurses were asked to determine the planning status and attendant by type (not name), and verify whether the birth took place at the mother's home or the home of a friend or relative. The nurses were not asked to contact either the midwives or parents.

- *Missouri Midwives Association (MMA)*—Listings of the same births that were sent to the county health departments were also sent to the Missouri Midwives Association. The association sent these listings to the midwives in their association as well as to other known midwives in the state. These midwives identified the births they attended, answered the other questions on the survey, and returned the listings to the MMA. After classifying the midwives as MMA-recognized or not, MMA sent the listings back to the state health department. Since names of midwives were not provided from other sources, MMA midwives could only be classified by MMA from these birth listings.
- *Physicians*—All physicians who certified home births (including the two known to attend large numbers of planned home births) were asked if they did in fact attend the birth at home and if it was planned that way. If not present, they were asked to identify what type of attendant was present at delivery as well as planning status.
- *Certified Nurse Midwives (CNMs)*—Since this group signs birth certificates, they were contacted primarily to verify the completeness and accuracy of the list of births the state has for each CNM. They were also asked the three basic survey questions for each birth.
- *Hospitals*—For neonatal deaths, the hospital where the death occurred was contacted and asked the basic set of survey questions. Surveys were also sent to hospitals for births certified by resident physicians at teaching hospitals.
- *Parents*—In the case of home births for which we could not obtain a complete response from any other source, a survey was sent to the parents.

A more intensive effort was made to identify the planning status and attendant type for all home births resulting in neonatal death. In addition to the sources mentioned above, funeral directors, emergency medical services, and the hospital of initial transfer were sometimes contacted, and the birth and death certificates were reviewed individually.

Data regarding admission to neonatal intensive care units (NICUs) have been collected since 1980 by the Missouri Department of Health on a voluntary basis from all major NICUs in the state. The home birth file was merged with this NICU file to verify birth weight and gather additional information, particularly about the very low birth weight infants (VLBW, under 1500 grams). When the birth weight on the birth certificate was widely divergent (more than 100 grams difference) from the NICU birth weight, the NICU weight was used.

Survey Responses

The number of sources contacted, and survey response rates by source are presented in Table 1. Information was received from one or more sources for 3,345 births or 80.7 per cent of the original 4,146 births. After the exclusion of 92 non-home births, 4,054 remained in the study sample. For 616 of these cases, information was received from multiple sources. For the multiple source records, there was general agreement although a few inconsistencies did occur. Planning status agreed on 96 per cent of the multiple source records; attendant types agreed for 87 per cent of the records with multiple sources.

When inconsistencies occurred, more weight was given to sources present at birth than to those obtaining information through indirect means. For example, information from midwives and physicians was considered more reliable than information from county health nurses. Planning status was considered most reliable from parents. In some instances, particularly neonatal deaths, sources were recontacted to determine their reliability.

For 392 of the 801 home births in which no source returned information, some assumptions about the birth data were made that were true in 95 per cent or more of the known cases. The 95 per cent criteria for assumptions generally held for neonatal deaths as well as those who survived. These assumptions were:

- If any midwife, or a physician known to regularly attend planned home births signed the birth certificate, it was assumed to be planned.
- If the certifier on the birth certificate was one of the parents, the mother was married and an Apgar score was reported, it was assumed to be planned with an unknown attendant.
- If the certifier was a physician, the mother was unmarried, but no Apgar score was reported, the home birth was assumed to be unplanned.
- If the baby weighed less than 1500 grams, it was assumed to be unplanned.

After those assumptions were made, planning status was determined for 3,645 home births and attendant type for 3,547 records. These represent completeness rates of 89.9 and 87.5 per cent, respectively.

For neonatal deaths, planning status and attendant type were determined for 50 of 62 neonatal deaths from at least one of the six source types. Because of the intensive follow-up for

TABLE 2—Per Cent Distributions of Selected Demographic Risk Factors by Planning Status by Attendant Type

Planning Status and Attendant Type	N	Black Other Races	Age of Mother		Education of Mother		Unmarried	Smoked during Pregnancy	Birth Order 6+	Low Birth Weight	Adequate* Prenatal Care
			<20	35+	<12	13+					
Planned Home Births											
Higher Level of Training											
Physicians	1,156	5.2	4.4	6.0	14.3	49.7	5.3	8.9	3.4	2.2	47.9
CNMs	218	1.8	4.1	4.6	6.9	60.8	3.7	11.3	3.2	1.8	81.0
MMA Midwives	396	2.8	2.5	9.6	20.8	58.9	4.3	7.0	11.1	2.5	65.7
Total Higher Level	1,770	4.2	4.0	6.6	14.8	53.1	4.9	8.8	5.1	2.3	55.9
Lower Level of Training											
Non-MMA Midwives	725	6.5	4.7	12.5	69.4	13.4	5.4	6.3	25.4	4.8	15.2
Other	474	3.2	1.9	10.6	26.5	33.1	3.8	11.2	16.2	4.6	29.5
Total Lower Level	1,199	5.2	3.6	11.7	52.5	21.1	4.8	8.2	21.8	4.8	20.0
Total Planned**	3,067	4.6	3.9	8.6	29.5	40.5	4.9	8.9	11.6	3.4	43.3
Unplanned	578	38.6	27.6	6.1	41.2	19.1	54.5	41.0	4.5	25.6	41.0
Hospital Births	525,645	16.4	15.9	4.4	23.0	32.0	18.4	30.5	1.5	6.8	82.4

NOTE: Unknowns were excluded when calculating per cents.
*Adequate prenatal care was defined as care beginning in the first four months of pregnancy with at least eight visits for pregnancies 37 weeks or longer or five visits for pregnancies less than 37 weeks.
**Includes unknown attendant type.

neonatal deaths, multiple sources were used for 30 deaths, two of which resulted in inconsistencies. After the assumptions were used, planning status and attendant type were determined for all 62 neonatal deaths of infants born at home.

Analytical Techniques

Neonatal mortality (death before 28 days of life) was the primary outcome variable used in this study. It is considered the most accurate, objective, and easy to define outcome variable. Stillbirths were not used because it was felt that home stillbirths would be underreported. Home births were stratified by planning status and attendant type. The expected number of neonatal deaths for each category was adjusted for race, age of mother, and birth weight using the indirect method of standardization.[7] Missouri resident physician-attended hospital births for 1978–84 were used as the standard rates. Race categories were White and other; age of mother categories were less than 20, 20–34, 35+ years; birth weight groupings were 250 gram increments for weights under 3000 grams and 500 gram increments for weights 3000 grams or more.

The result was an observed number of deaths vs an expected number for each subcategory. A relative risk (RR) and 95 per cent confidence interval (CI) were calculated using a method outlined by Kleinman.[7] For large proportions (20 to 80 per cent), the CI was calculated using 1.96 times the standard error for proportions divided by the expected proportions.

Results

Demographic Risk Factors

Of the 3,645 home births whose planning status was available, 3,067 (84.2 per cent) were planned to be at home. Physicians attended the largest number of planned home births (1,156) during the 1978–84 time period, followed by non-MMA midwives (725), father and other attendants (474), MMA midwives (396), and CNMs (218).

Generally, planned home births were at lower risk demographically than unplanned home births or hospital births as shown in Table 2. The proportion of teenage births, unmarried mothers, Black births, or smoking mothers among planned home births was one-fourth to one-third the levels for hospital births.

Nearly 70 per cent of mothers using non-MMA midwives had less than a high school education. Maternal education levels of unplanned home births were lower than those of hospital births, but not as low as those attended by non-MMA midwives. Births attended by non-MMA midwives or other attendants had particularly large proportions of older mothers and higher birth orders.

The low birth weight (under 2500 grams) rate for unplanned home births of 25.6 per cent was nearly eight times the planned home birth rate (3.4 per cent) and nearly four times the hospital rate (6.8 per cent). The low birth weight (LBW) rate for planned births of attendants with a lower level of training (4.8 per cent) was about double the rate for those with a higher level of training (2.3 per cent) but still lower than the rate for hospital births.

The rate of adequate prenatal care was generally lower among home births than hospital births. The adequate prenatal care rate was 55.9 per cent for planned home births attended by those with a higher level of training, only 20.0 per cent for those with a lower level of training and 41.0 per cent for unplanned home births. Only home births attended by CNMs (81.0 per cent) approached the hospital prenatal care rate (82.4 per cent).

Neonatal Deaths

There were 17 observed deaths for planned home births compared with 8.59 expected for a relative risk (RR) of about 2 to 1 (Table 3). Nearly all of the excess was found in the two attendant types with the least training: non-MMA midwives, and the "other" category. For these two groups combined, there were 12 observed neonatal deaths vs 4.42 expected for an RR of nearly 3 to 1. For the three attendant types with the highest level of training (physicians, CNMs, and MMA-recognized midwives) there were five neonatal deaths compared with 3.92 expected.

Neonatal deaths for unplanned home births were over 35 per cent higher than expected (45 vs 33.19). There was little difference between observed and expected deaths for unplanned home births weighing less than 1500 grams. However, as Table 4 shows, for babies weighing at least 1500 grams, 19 deaths occurred compared with only 3.50 expected, for an RR of more than 5 to 1.

TABLE 3—Observed and Expected Neonatal (under 28 Days) Deaths with Relative Risks (RR) by Planning Status by Attendant at Delivery

Planned Status and Attendant Type	Live Births	Neonatal Deaths		RR	95% Confidence Interval of RR
		Observed	Expected		
Planned Home Births					
Higher Level of Training					
Physicians	1,156	4	2.58	1.55	0.58– 4.13
CNMs	218	1	0.42	2.38	0.34–16.89
MMA midwives	396	0	0.93	0.00	—
Total Higher Level	1,770	5	3.92	1.28	0.53– 3.08
Lower Level of Training					
Non-MMA Midwives	725	6	2.63	2.28	1.02– 5.08
Other	474	6	1.79	3.35	1.51– 7.46
Total Lower Level	1,199	12	4.42	2.71	1.54– 4.77
Total Planned*	3,067	17	8.59	1.98	1.23– 3.18
Unplanned	578	45	33.19	1.36	1.01– 1.82

NOTE: Expected deaths were calculated based on race-age of mother-birth weight specific neonatal death rates for Missouri resident physician-attended hospital births.
*Includes planned home births with unknown attendant type.

Survey results showed that 95 per cent of infants weighing less than 1500 grams (VLBW) born unplanned at home were transferred to hospitals within 48 hours. The proportion of these infants transferred to NICUs (50 per cent) was about the same as the statewide rate for babies of this weight (54 per cent). Transfer times were calculated for the 20 VLBW infants born at home and admitted to NICUs according to available data (1980–84). These 20 infants were admitted to NICUs within an average of three hours and five minutes after birth (range five minutes to 10 hours, 45 minutes).

To determine the possible effect of assigning planning status and attendant type from assumptions and inconsistencies, an additional analysis was done excluding these records. As Table 5 shows, the mortality patterns of planned home births by attendant type, and unplanned home births by birth weight, remained essentially the same as the patterns with the more complete data set.

About one-third of the inconsistencies noted in the methods section resulted from county health nurses apparently overreporting father-attended planned home births. To see what effect this overreporting might have on the results, the 166 reported "other" attended births with a county health department as the single source of information were excluded. Since none of these births was classified as a death, this exclusion increased the RR for attendants with a lower level of training from 2.7 to 3.4.

TABLE 4—Observed and Expected Neonatal Deaths with Relative Risks (RR) by Planning Status by Birth Weight

Planning Status and Birth Weight	Live Births	Neonatal Deaths		RR	95% Confidence Interval of RR
		Observed	Expected		
Planned Home Births					
Under 1500 grams	2	0	1.36	0.00	—
1500 grams or more	3,043	17	7.23	2.35	1.49–3.70
Unplanned Home Births					
Under 1500 grams	62	26	29.69	0.88	0.62–1.13
1500 grams or more	516	19	3.50	5.43	3.46–8.51

NOTE: Expected deaths were calculated based on race-age of mother-birth weight specific neonatal death rates for Missouri resident physician-attended hospital births.

Two physicians, one from the Missouri Department of Health and one who delivers home births, reviewed the home birth and death certificates for possible preventability of death. Their major conclusion was that there was not enough information on these documents to clearly determine preventability, except in a few cases. These probably preventable exceptions included two planned home births delivered by "other" attendants and six unplanned home births weighing at least 1500 grams. Only two planned home births ended in neonatal death from malformations, both attended by physicians. Both were major malformations: tetralogy of Fallot, and duodenal atresia.

Discussion

In summary, although neonatal mortality was apparently excessive for both total planned and unplanned home births compared with hospital births, the more important results are in the subcategories of these totals. Nearly all of the mortality excess for planned home births was among lesser trained attendants while for unplanned home births all of the excess was found for babies weighing 1500 grams or more. Although results should be interpreted cautiously due to the small number of events available for study, neonatal mortality was similar to hospital births for planned home births delivered by

TABLE 5—Observed and Expected Neonatal Deaths with RR, by Planning Status after Exclusion of Records Assigned by Assumptions and Inconsistencies

Planning Status and Birth Weight	Live Births	Neonatal Deaths		RR	95% Confidence Interval of RR
		Observed	Expected		
Planned Home Births					
Higher Level of Training	1,688	5	3.73	1.34	0.56–3.22
Lower Level of Training	1,000	10	3.75	2.67	1.44–4.96
Total	2,688	15	7.48	2.01	1.21–3.33
Unplanned Home Births					
Under 1500 grams	35	17	18.51	0.92	0.57–1.48
1500 or more grams	393	16	2.71	5.90	3.61–9.63
Total	428	33	22.01	1.50	1.07–2.11

NOTE: Expected deaths were calculated based on race-age of mother-birth weight specific neonatal death rates for Missouri resident physician-attended hospital births.

skilled attendants and for unplanned very low birth weight home births.

The findings of this study are somewhat comparable to the Burnett[3] study in North Carolina and the Hinds[4] study in Kentucky. But Missouri's larger data base enabled us to break out home births by more subcategories. In Missouri, 3,067 planned home births were identified compared with 934 in the North Carolina study and 465 in the Kentucky study. The Missouri crude neonatal mortality ratio of unplanned home births to planned home births of 14 to 1 was similar to the 18 to 1 and 20 to 1 ratios found in North Carolina and Kentucky, respectively. The Missouri study was the only one to find an excess among planned home births after adjustment for birth weight.

A second factor that may have affected the Missouri planned home birth death rate is that the level of care for home births in Missouri may be less than that in the other two states. Approximately 40 per cent of the Missouri planned home births were attended by non-MMA midwives and other attendants. This may partly reflect the difficulty many parents have in finding adequately trained midwives in Missouri. The lack of midwife registration has driven most qualified Missouri midwives underground as evidenced by the few MMA midwives that signed birth certificates. Many Missouri parents have unattended home births stated on their survey that they would have preferred to have a midwife present, but could not find one.

The lack of a mortality increase for unplanned home births weighing less than 1500 grams is rather surprising. Several factors were examined to possibly explain this unusual findings.

The comparison between NICU weights and the weights reported on birth certificates revealed that underreporting of birth weights, particularly those under 1000 grams, may have affected results. As a consequence, an intensive effort was made to verify birth weights of surviving unplanned home births under 1000 grams. Thirteen out of 16 of these birth weights were either confirmed or corrected. Altogether, seven of 28 records checked were found to be apparently underreported, and therefore were corrected with the NICU weight. There may have been other VLBW home births that were inaccurate but were not verified.

VLBW unplanned home births usually occur because of sudden unexpected premature deliveries, i.e., mothers intended to deliver their babies in hospitals but could not reach them in time. Nearly all these infants were transferred to hospitals shortly after birth, and about half were admitted to NICUs within an average of three hours after birth, data comparable to hospital births.

The nature of the relative risk may partly explain the VLBW finding. For VLBW infants, the mortality risk is high regardless of place of birth. It is logical to assume that VLBW babies born at home would be at greater risk than those born in hospitals, but the increased relative risk may be too small to be detected with the small numbers in this study.

Other possible sources of error include missing data and misclassification. Planning status was determined for 90 per cent and attendant type on 87 per cent of the home births in Missouri from 1978–84. The missing births represented only 1.8 expected deaths and no observed deaths. Even if all of the unidentified births had fallen into one category, an unlikely event, the major conclusions of the study would not have been changed.

There also may be additional home births for which the state has no birth certificate. Assuming the same rate of delayed records applied for all years in the study, it is estimated that there may have been as many as 100 home birth certificates from the years 1982 to 1984 for which the state had no record by the October 15, 1985 cutoff date for the study, but will probably be received after that date. There may be some additional home births for which the state will never have a birth certificate. Since it took about 300 planned home births to equal one expected death, it is unlikely that the inclusion of these missing records would have appreciably affected the results.

There also may be neonatal deaths for which no death certificates were turned in to the state. This event is probably less likely than a missing birth certificate of a healthy child because other agencies in the vital registration system are involved such as funeral directors or hospitals. A missing death certificate would be more likely to occur among unattended home births rather than births attended by persons with higher levels of training, i.e., physicians, CNMs, or lay midwives. Thus if there are any of these missing deaths for planned home births, they would probably increase the mortality differential between attendants by training level.

There may be some missing birth and death certificates for unplanned home births under 1500 grams. However, we verified from sources independent of vital registration that all 12 infants born at home weighing under 1000 grams without a death certificate, did in fact survive the neonatal period.

Misclassification presented another problem, especially if it occurred among the neonatal deaths in the study. For example, there may have been many births classified as attended by non-MMA midwives that were actually delivered by well-trained lay or nurse midwives and the Missouri Midwives Association simply lacked knowledge about them. However, it did not appear that any of the six neonatal deaths attended by non-MMA midwives were misclassified in this way. None of the six birth certificates for these deaths had a reported Apgar score or an adequate level of prenatal care, both of which were prevalent among the MMA midwives. For the "planned, attended other" and unplanned home births that resulted in deaths, there was also little evidence of professionals being present at birth. Exclusions of possibly misclassified data presented in the results section also lead to the conclusion that misclassification did not have a major impact on results.

Despite the fact that the Missouri study had a much larger population than other home birth studies, small numbers are still a problem. Less than 1 per cent of Missouri's births took place at home during the study period.

As in the other studies on this subject, we were unable to fully identify births or neonatal deaths related to deliveries intended to be at home but transferred during labor to a hospital because of complications. Studies in California,[8] Arizona,[9] and New York[10] found transfer rates ranging from 12 and 16 per cent. It is logical to assume that generally transfers during labor would result in a higher neonatal mortality rate than home births, particularly if the transfer were due to prematurity. Inclusion of these unidentified transferred births might have altered results somewhat.

Another important limitation is that we only examined neonatal deaths and not fetal deaths. This was done because we felt stillbirths would be underreported, particularly home stillbirths. These events were examined in the aggregate, however; there were 53 observed home fetal deaths versus 43.4 expected, but this has little meaning without the availability of breakdowns by planning status and attendant type. The practicing definition of live birth or stillbirth may vary

between hospital and home setting, especially for very small premature births. It is recommended that future studies of this type include all perinatal deaths.

Despite these limitations, the study provides evidence of the importance of having well trained attendants present at home births. Well over one-third of Missouri's planned home births were attended by persons with little or no training and neonatal deaths were excessive for these lesser trained attendants.

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WHO Study Group Calls for Preemptive Ban on Smokeless Tobacco

A group of experts meeting under the aegis of the World Health Organization (WHO) has called for a preemptive ban on smokeless tobacco, wherever possible, to "prevent a new public health epidemic from a new form of tobacco use." Smokeless tobacco is "now being promoted cynically and aggressively around the world despite its known harmful health consequences," the group said as the basis for its recommendations.

Studies have shown "beyond any reasonable doubt," according to a WHO working paper presented to the experts, "that smokeless tobacco is a serious health hazard as a cause of cancer of the oral cavity and of nicotine addiction." Its use has led to leukoplakia, white patches on gums, which in turn may develop into cancer, and to gums that recede away from the crowns of teeth thereby leaving roots exposed. Its addiction, the paper says, is "similar to that produced by cigarette-smoking and by other addictive drugs such as morphine or cocaine."

Among measures called for by the WHO experts are the prohibition of sales to children and adolescents, the prohibition of promotion in the mass media, as well as the involvement of health personnel and teachers. Also recommended are a series of rotating health warnings on all smokeless tobacco products and advertisements, with such messages as:

- Smokeless tobacco causes oral cancer;
- Smokeless tobacco is not a safe alternative to cigarette smoking;
- Smokeless tobacco kills;
- Smokeless tobacco is addictive; and
- Smokeless tobacco causes gum and teeth disease.

Dr. Gregory N. Connolly, Director of Dental Health, Department of Public Health, Boston, was Chairman of the group. "Based on the experience in Sweden and the United States, if countries do not act now, tens of millions of children could become addicted to smokeless tobacco, and many will develop oral health problems—including oral cancer," he said. "We hope to alert governments to the irresponsible marketing of a new tobacco product to the world's young people, and to urge them to launch programs to eradicate, or to prevent, the use of smokeless tobacco. It is vital that we act now to prevent the epidemic from spreading throughout the world, and that we do not repeat the mistakes which have led to the massive health problems caused by cigarette smoking."