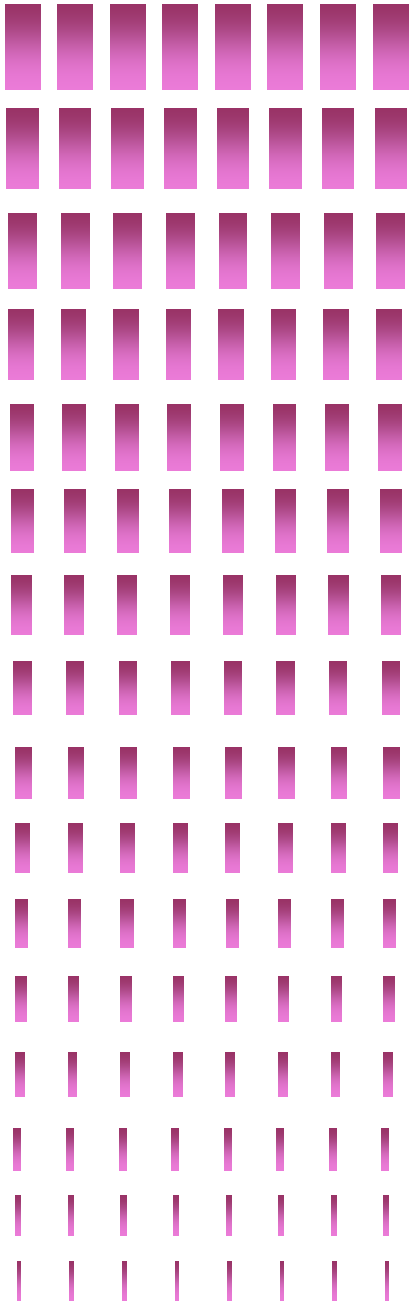

## Independent Review
## By Statistical Consultant

# Time Study Proposal

## School Based
## Medicaid Administrative Match Program
## Washington State

**October – December 2003**

**Prepared by:**
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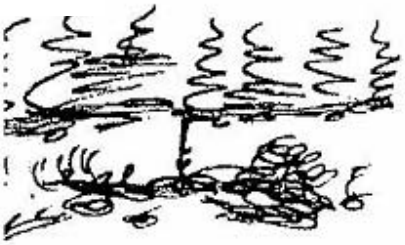

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10-2-03

Dick Hancock, Manager
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At the request of Dr. Dario Longhi in the Research and Data Analysis Division of DSHS, I have reviewed the sampling plan for determining the statewide mean percentage of school staff time spent on Medicaid-related activities.

I have focused exclusively on two issues:

1) Does the plan provide an unbiased estimate of this mean percentage?
2) Will the sample size and plan provide a sufficiently precise estimate of the mean percentage?

I understand that the criterion for a sufficiently precise estimate is that there be no more than 5% error. In keeping with common practice in statistics, I have defined the "5% error" to mean that the upper and lower bounds of a 95% confidence interval for the calculated mean percentage will differ by no more than a relative five percent from the estimate of the mean percentage. For example, using this definition, suppose that the final mean statewide estimate is 3.00% of time spent on Medicaid activities. The "5% error" means that the upper and lower bounds of the confidence interval would have to lie within ±0.15% of the estimate, because 0.05×3% = 0.15%. Thus, by whatever method is used to define the upper and lower confidence bounds (such as adding and subtracting 1.96 times the standard error), if the resulting bounds lie within the interval 3%±0.15%, or, equivalently, the interval [2.85% to 3.15%], then the goal of less than 5% error has been met.

I have reviewed the sampling plan contained in the document "Time Study Proposal: School Based Medicaid Administrative Match Program, Washington State", dated October 2003. This document addresses a number of issues aside from the two items noted above, but has an ample and sufficient description of the sampling plan. I have also spoken with Dr. Longhi at length about the sampling plan.

The practical steps of sampling, data collection and analysis will be a major effort. I have not reviewed the plans for training, for management of operations, and other logistical features of the project. I have exclusively focussed on the issue of whether the results reported to the federal government will be unbiased and precise. As noted below, the plan does fulfill those two objectives.

First, the sample plan is unbiased. A number of strata are defined for drawing samples, and within each stratum, samples will be drawn randomly. The strata are well-chosen, consisting of units that can be expected to have different mean percentages, such as size of school district, and, within the district, designated staff vs. teachers and other staff. The method of random selection—so important to achieve an unbiased estimate—is followed consistently. Even within strata where 100% of the staff will be selected (which is good), the particular school days which will be sampled in a district will be designated randomly. I note also that a random method is used not only to select the staff and teachers, but, also, the five days within the quarter that are to be used for time accounting are also randomly selected per district.

As the report indicates, the mean percent time estimates from the strata can be combined by an appropriate weighting method (based on FTE in each stratum) to yield an unbiased estimate of the mean percentage for the state.

Second, the sample size is large enough that the estimate of mean percentage Medicaid time can be expected to be quite precise, probably bettering the precision requirement of 5%. The total sample size for the state is expected to be 23,814 staff, including 14,640 teachers in schools where there will be less than 100% sampling of teachers. Each selected person will offer five days of time accounting data. While this is very few days per person, it will help to reduce the within-person variance and, thus, the variance of the final estimated mean statewide percentage. I believe that the main source of variance is going to be between persons rather than across days within a person. I reviewed some of the mean percentages from districts in the previous time study survey and found a very large district effect, with quite varying mean percentages per district. I believe that this will be mirrored in quite large differences among individuals within a district, certainly between designated staff vs. teachers + other staff. If this is the case, then the variance (and precision) of the stateside estimate will be dominated by between-person differences rather than by within-person differences. The between-person differences are very unlikely to exceed the coefficient of variation (CV) of 3.1 noted as an upper limit of acceptable variation in the report. The coefficient of variation is the standard deviation divided by the mean, and it expresses the variation relative to the mean.

However, even if all of the persons sampled had exactly the same expected percent time (a very unrealistic assumption, but conservative), then the study will still have the required precision, based on the five sampled days per person. In this unrealistic case, the precision can be described as follows. The five days include 130 of the 15-minute segments for each person sampled. Suppose that the intervals within a person are so highly (and unrealistically) correlated, with a correlation coefficient of 0.9, so that the effective sample size per person is about 13 (rather than 130). This unrealistic, very conservative correlation is so high that it means that most of the time a person would be doing the same thing in any pair of 15-minute periods—an unlikely uniformity. If the expected percent time per person is 3%, then the coefficient of variation across people would be 1.6, which is well below the acceptable limit value of CV = 3.1 noted in the report. If the expected percent time is 2%, then the CV across people would be 1.9, again well below the value of CV = 3.1. Thus, the five days, combined with the large number of persons sampled, is very, very likely to give the required precision or better.

The challenge in selecting the sample size is the lack of variance estimates to guide the choice. The plan uses an initial method to select a sample size and then shows that the selected sample size is very likely to fulfill the 5% precision criterion under the conservative assumption of a simple

(unstratified) random sample and large variances. (Actually, because the variances are unknown, the report uses large coefficients of variation.) Because the actual sample will be drawn using an appropriate stratification, the precision will be better than that of the simple random sample conservatively used in their sample justification. In short, the precision of the statewide estimate is likely to be very good and probably better than the 5% requirement.

The report notes some potential improvements in the sampling strategy that can be based on results of the first quarter of sampling. After the sample has been drawn and the data have been collected, there will be some fairly technical calculations to determine the variance of the estimates and the precision, but most of the data needed for these calculations should be available. The data can also be analyzed in a way that will lead to improvements in sampling strategy for the next round, along the lines suggested in the report. Again, some of these calculations will be quite technical, but the data needed should be available.

In summary, the sampling plan is sound, unbiased, and the precision is very likely to meet or better the stated goal of 5%.

Yours sincerely,

Nayak Polissar

Nayak Polissar, Ph.D.

LETTERHEAD

December 9, 2003

Richard Hancock, Manager
School Administrative Match Section
Medical Assistance Administration
Department of Social and Health Services
805 Plum St. SE
Olympia WA 98504-5508

Dear Mr. Hancock:

I have reviewed the three questions that are of concern to the Medical Assistance Administration (MAA) of the Department of Social And Health Services in relation to conducting time studies for the School Administrative Medicaid Match program among the staff of participating school districts. The questions were contained in an e-mail message from Dr. Elizabeth Kohlenberg directed to me and dated October 23, 2003.

The questions ask further about determining the precision of the estimate of the proportion of time spent on Medicaid activities. These questions arise because the contextual situation may change in the future. My understanding of the potential changes are as follows: :

1) fewer Medicaid activities may be reimbursable, perhaps, therefore, eliminating the rational for sampling teachers; and
2) fewer school districts may participate in the program, thereby decreasing the total sample sizes statewide in various categories.

The new contextual situation has been defined to me by DSHS staff as follows:

*" MAA is considering eliminating the idea of sampling the teachers and school staff who, they perceive, only occasionally make referrals and engage in activities that are still reimbursable under the new federal guidelines … This would give districts only two realistic options: either reporting on all eligible staff (such as in the small districts, with less than 150 FTEs) or on all 'designated ' staff in the larger districts.*

*“This action would eliminate the stratification for sampling persons from the design, leaving only the sampling of time per quarter per staff member reporting.*

*“We suspect that the smaller districts would report the time of all staff (n=5,199) and the larger districts would report the time of only 'designated staff (n=2,650 to 5,298)."*

The three questions of concern to Dr. Kohlenberg were:

1) **Would MAA be able to reach the required federal precision levels for the state with five randomly assigned days of sampling per quarter for each staff person?**

   a. **If the answer is no, how many days per staff person would be required?**

   b. **How does that number of days change if fewer districts or fewer staff participate?**

2) **Is there some time sampling scheme other than days that you would recommend to reduce the respondent time-study burden? Maybe randomly sampling some smaller blocks; e.g., two hours at a time?**

3) **MAA states they need to develop a method of distributing funds to the school districts that is hard to challenge. If they wanted to reach the federal level of precision for each school district, would the number of time blocks required per participating staff member change? How, and is that change dependent on the number of staff participating?**

In order to address these questions, I built a statistical model for the percentage of time that individual staff members spend on Medicaid activity and assumed that each staff member's work days during the quarter (60 days) are sampled randomly for five or some other number of days (assumed to be the same sampling grid of days for each school district, but varying from district to district). I varied the 5-day value to other quantities to study the impact of the number of days on the precision of the estimated proportion of time spent on Medicaid-related activities during the quarter for all of the participating school districts combined.

In consultation with Dr. Dario Longhi I used plausible values for sample sizes and expected proportions of time spent on the target activities, both for the population of relevant staff members in the participating school districts and the expected average proportion of time that they would spend on the Medicaid-related activities. For my analysis the school districts were divided into three strata of concern to you: 1) designated staff in large school districts; 2) designated staff in small school districts; and, 3) non-designated staff in small school districts. I understand that within these three strata 100 percent of the staff would participate in the assessment of time and that each staff member would report on time for a certain number of full workdays. One of your questions concerns possible variations in this format, and I do discuss that below. I shall also put some technical information at the end of this letter.

A key item driving precision in this analysis is the day-to-day variability in the proportion of time spent by a staff member on the Medicaid activities. I wish you to know that I used conservative assumptions on this variability.

Table 1, below, shows the estimated precision for various scenarios of sample size per stratum, expected proportion of time spent on Medicaid-related activities per stratum, and, for a specified staff member, the correlation of activity between sampled days. (The first version of Table 1, abbreviated, is complemented by an extended version showing more details about assumptions, later in the letter, along with a fuller description of methods.)

This item, "correlation of activity", may be a little bit puzzling to you. It is an estimate of how similar a particular staff member's activities are across the sampled days; or, more specifically, how similar the staff member's proportion of time spent on Medicaid-related activities is among the days sampled. It is a correlation calculated within the experience of a single staff member, and it is not a correlation reflecting similarity or dissimilarity of the proportion of time across the various staff members. If a specified staff member did very similar the activities every day, the correlation would be close to 1.0 (perfect correlation is 1.0, and no correlation is 0.0). If a staff member used varying and random proportions of time on Medicaid-related activities from day-to-day, then the correlation would be 0.0 or close to 0.0. The correlation is important, because larger correlations result in less precision for a given number of days sampled per person per quarter.

The results in Table 1 show that across all of the plausible expected scenarios the precision will be better than the 5 percent required by the Federal government. Lower percentages indicate better precision. The precision for 10 days of sampling is better than for five days (bottom two rows of the table), but the gain from this doubling of sampled days is quite small and probably not worth the doubling of the effort.

Please note that these precision values are not drastically better than 5 percent. I would hesitate to cut back on the sample size of staff assessed much more than those you see in Table 1. Even though I used conservative assumptions, I recommend that some margin of safety be incorporated by using these sample sizes.

In answer to the three questions posed, my response is as follows:

**Question 1: Would MAA be able to reach the required federal precision levels for the state with five randomly assigned days of sampling per quarter for each staff person?**

**a. If the answer is no, how many days per staff person would be required?**

**b. How does that number of days change if fewer districts or fewer staff participate?**

The answer is "yes". The State should be able to reach the required precision with the sample size indicated in Table 1. In answer to **1a**, you can see there is minimal impact of the extra days beyond five. It is not going to help precision very much just to add a few more days per person. Five days is a reasonable choice.

In answer to Question 1B, I have answered that by showing the precision for a smaller sample size arising from fewer districts participating, indicated by the last two columns of the table. You can see that the precision is still acceptable for these smaller sample sizes, such as in the last column, where approximately half of the usual number of districts would participate.

**Question 2: Is there some time sampling scheme other than days that you would recommend to reduce the respondent time-study burden? Maybe randomly sampling some smaller blocks; e.g., two hours at a time?**

In response to this Question, I would recommend continuing with the entire work day of a staff member as the unit of sampling rather than smaller blocks of time. The proportion of time used is small enough (typically under 20%) that each smaller block of time (such as two hours) is less likely to include Medicaid-related activities. If (by way of contrast) a staff member was carrying on an activity that was done very frequently throughout the day but perhaps in one or two minute "doses" (such as speaking), then sampling smaller blocks of time would be very feasible, because even rather small blocks of time would be likely to reflect and be somewhat representative of the average proportion of time that a staff member spends on the activity.

For the Medicaid-related activities, however, it is probably going to happen that most staff members will do these activities in some chunks during the day rather than spread out in many little bits throughout the day. Therefore, the smaller blocks of time would have more block-to-block variability in the proportion of time spent on Medicaid than would the larger time units, such as the full work day. The consequence is that by using smaller blocks of time one would have to use many more blocks spread across more days, which would defeat the goal of lessening the burden on the participants. In addition, it is going to be harder to set up a system to randomly sample smaller blocks of time and ensure that the staff members would really audit the designated time periods. Therefore, I highly recommend not going to units of less than one day.

**Question 3: MAA states they need to develop a method of distributing funds to the school districts that is hard to challenge. If they wanted to reach the federal level of precision for each school district, would the number of time blocks required per participating staff member change? How, and is that change dependent on the number of staff participating?**

It would be very difficult to come up with accurate proportions for individual school districts, as is shown by Table 2, which reflects some examples for hypothetical individual district sample sizes and varying numbers of days sampled. There, with the expected proportions that are likely to occur, the precision is likely to be satisfactory (better than 5%) for very large districts (e.g., 5000 staff) and five days of sampling. In smaller districts, the precision is substantially worse than 5% unless a large number of days are sampled. For example, in the last two columns, a district with 500 staff would need 28 days sampled (out of 60) to reach the 5% precision, and the district with 150

staff would need 53 days out of the 60 sampled. However, the precision values noted in Table 2 for smaller districts and five days of sampling show that the estimates for individual districts, though not extremely precise, are not worthless. The State may not reach the stringent federal level of precision for these districts, but the State will do far better than an arbitrary assignment of the Medicaid time proportion for these districts. In some difficult field studies (such as this), a precision of ±20% may be considered acceptable.

That being said, the State will need to come up with some proportion as a basis for reimbursement and allocation for each school district. I would recommend that “similar” school districts be aggregated (districts that would expect to have a similar proportion) in order to achieve better precision.

I hope that this discussion is helpful to you. I think it is wonderful that the State is able to take advantage of this Medicaid program to help the children. If there is any way that I can use my statistical experience to legitimately support increased funding based on an accurate assessment, I will be happy to do so.

Finally, I wish to note that the plan developed by Dr. Dario Longhi will provide excellent data for planning future sampling programs. It is very likely that both the sample size and the selection of days (both dates and number of days) can be more carefully calculated based on the data to be collected.

Yours sincerely,

Nayak L. Polissar, Ph.D.
NLP/ds

## Table 1. Precision for various scenarios of sampling.

| | Scenarios | | | |
|---|---|---|---|---|
| | **VERY FAVORABLE: large sample size, large proportion Medicaid time, zero correlation** | **LESS FAVORABLE: medium sample size, medium proportions Medicaid time, medium correlation** | **MORE CHALLENGING: smaller sample size, smaller proportions Medicaid time, larger correlation** | **ONE HALF OF FULL SAMPLE (APPROXIMATELY)** |
| **Total sample size** | 10961 | 9306 | 7650 | 5150 |
| **Expected mean Medicaid proportion, entire sample** | 14% | 10% | 6% | 10% |
| **Precision (%), based on 5 days** | 1.0% | 1.7% | 2.8% | 2.2% |
| **Precision (%), based on 10 days** | 0.7% | 1.4% | 2.5% | 1.8% |

## Table 2. Precision for various sizes of individual school districts and number of days sampled.

| **Size of school district** | **5000** | **500** | **150** |
|---|---|---|---|
| **Correlation** | 0.15 | 0.15 | 0.15 |
| **Proportion of Medicaid time, designated staff*** | 15%* | 15%* | 15%* |
| **Precision, 5 days** | 3.3% | 8.7% | 19.1% |
| **Precision, 10 days** | 2.7% | 7.1% | 15.6% |
| **Precision, 20 days** | 1.2% | 5.8% | 12.7% |

Note: The expected proportion of Medicaid time for all staff is assumed to be 5%, and the proportion of staff who are “designated” is assumed to be 6%. The proportion of Medicaid time for non-designated staff is assumed to be 4.4%.

## Technical notes

The driving factor in the precision calculations is the within-person variance of daily time spent on Medicaid-related activities. Conservatively, we have started by treating that proportion as a Bernoulli random variable, so that each person would either spend an entire day on the activity or devote no time to it whatsoever on a given day. The proportion, then, would be either 1.0 (100% time for a day) or 0.0 (zero percent time for a day). The parameter, p, of the Bernoulli distribution was set equal to the average proportion of time expected to be spent on the activity within the school district and stratum (e.g., p = 0.10 for some of the scenarios). This use of the Bernoulli distribution is conservative, because the reality of staff members' schedules would most likely have them spending some fraction of a day, varying some from day to day, on the Medicaid activities. The staff members' schedules would not usually swing as widely from day to day as 100% to zero percent time devoted to Medicaid activities. Thus, the higher-variance choice of the Bernoulli distribution is a conservative selection. This choice was modified for the final presentation, as noted at the end of these technical notes.

The scenarios that we have illustrated assume that all of the staff members in the stratum will participate in the time assessment, with a specified number of days, such as five, assessed of all staff. The strata of school district staff are: 1) large school districts (SD), designated staff (staff who are designated to work on Medicaid-related activities), 2) small SDs, designated staff, and, 3) small SDs, non-designated staff.

The variance across days of the observed proportion of time spent per day for the i-th individual in the k-th stratum, is

$$\text{Var}(\text{obs } p_{ik}) = [p_{ik}(1 - p_{ik})n_{ik}^{-1} + (n_{ik} - 1)n_{ik}^{-1}p_{ik}(1 - p_{ik})r](1- n_{ik}/60)$$

Where
obs $p_{ik}$ = observed proportion of Medicaid time spent per day for the i-th individual in the k-th stratum ("obs" is used for observed quantities below, as well),
$p_{ik}$ = expected proportion of time spent per day for the i-th individual in the k-th stratum (assumed to be constant in the stratum),
$n_k$ = the sample size of the k-th stratum,
$n_{ik}$ = the number of days sampled for the i-th individual in the k-th stratum (assumed constant in the stratum),
r = correlation between the observed proportions of time spent on Medicaid-related activities for pairs of days in the sample of $n_{ik}$ days for an individual, and,
60 = the number of days in a school quarter.

The proportion of time spent on Medicaid activities in the k-th stratum is then

$$p_k = (\sum_i p_{ik})/n_k$$

with variance for the observed value given by

$$\text{Var}(\text{obs } p_k) = \text{Var}(\text{obs } p_{ik})/n_k$$

$$= [p_{ik}(1 - p_{ik})n_{ik}^{-1} + (n_{ik} - 1)n_{ik}^{-1}p_{ik}(1 - p_{ik})r](1- n_{ik}/60)/n_k.$$

The notation is as before. Finally, the proportion of time spent on Medicaid-related activities in the entire population of participating SDs is p, given by

$$p = (\sum_k n_k p_k)/n,$$

where
$n = \sum_k n_k$, the total population of staff members being assessed in the state.

The variance of the observed value of p is

$$\text{Var}(\text{obs } p) = \sum_k n_k^2 \text{Var}(\text{obs } p_k)/n^2.$$

The estimation of the variances in these equations has been carried out by using plausible assumed values for the population parameters, such as $p_{ik}$.

The absolute precision is calculated as the half-width of a 95% confidence interval for the observed quantity. (Given the approximate nature of the assumptions and the parameters themselves, we have used 2.0 standard deviations rather than 1.96 to correspond to the 95% level of confidence). The relative precision is just the absolute precision as a percentage of the estimated quantity. Specifically,

$$\text{Precision} = 2*100\%*[\text{Var}(\text{obs } p)]^{1/2}/(\text{obs } p).$$

For presentation in this letter, the assumed population values of $p_{ik}$ and other parameters have been used as “plug-ins” to the various equations..

A final adjustment to the precision has been made. The variance from the Bernoulli distribution is probably much higher than that of the variance of day-to-day teacher Medicaid time proportions. After experimenting with examples of beta distributions for the daily value of the proportion, we found that distributions that looked plausible tended to have a standard deviation that was about half or less of the Bernoulli distribution. Thus, the Bernoulli-based precision percentage was multiplied by one-half to yield a final presentation precision value.

**Table 1 (extended). Precision for various scenarios of sampling.**

| | Scenario | | | |
|---|---|---|---|---|
| | **VERY FAVORABLE: large sample size, large proportion Medicaid time, zero correlation** | **LESS FAVORABLE: medium sample size, medium proportions Medicaid time, medium correlation** | **MORE CHALLENGING: smaller sample size, smaller proportions Medicaid time, larger correlation** | **ONE HALF OF FULL SAMPLE (APPROXIMATELY)** |
| | **Sample sizes** | | | |
| **Large school districts, designated staff** | 5961 | 4306 | 2650 | 2650 |
| **Small school districts, designated staff** | 400 | 300 | 200 | 100 |
| **Small school districts, non-designated staff** | 4600 | 4700 | 4800 | 2400 |
| **Total sample size** | 10961 | 9306 | 7650 | 5150 |
| | **Proportion of Medicaid time and correlation** | | | |
| **Large school districts, designated staff** | 20% | 15% | 10% | 15% |
| **Small school districts, designated staff** | 20% | 15% | 10% | 15% |
| **Small school districts, non-designated staff** | 5% | 4% | 4% | 5% |
| **Expected mean Medicaid proportion, entire sample** | 14% | 10% | 6% | 10% |
| **Correlation** | 0 | 0.15 | 0.3 | 0.15 |
| | **Precision** | | | |
| **Precision (%), based on 5 days** | 1.0 | 1.7 | 2.8 | 2.2 |
| **Precision (%), based on 10 days** | 0.7 | 1.4 | 2.5 | 1.8 |

# CURRICULUM VITAE

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Education:

University of California, Berkeley, BA, Mathematics, 1966
Princeton University, New Jersey, MA, Statistics, 1968
Princeton University, New Jersey, PhD, Statistics, 1974
(Dissertation supervisor: John Tukey)

Professional Positions:

Physical Science Aide, U.S.N. Radiological Defense Laboratory, San Francisco, 1958-59
Principal Data Analyst, Lawrence Radiation Laboratory, Berkeley, CA 1961-66
Demographic Intern, The Population Council, New York City, 1967
Statistical Consultant, New Jersey Neuro-Psychiatric Institute, 1967-1968
Computer Clinic Consultant, Princeton University Computer Center, 1967-1968
Research Assistant, Statistics Department, Princeton University, 1968
Field Associate, Thailand and Indonesia, The Population Council, 1969-1971
Teaching Assistant, Statistics Department, Princeton University, 1974
Assistant Member, Fred Hutchinson Cancer Research Center, Seattle, WA, 1974-1982
Associate Member, Fred Hutchinson Cancer Research Center, Seattle, WA, 1982-1989
Assistant Professor, Department of Biostatistics, University of Washington, 1974-1982
Associate Professor, Department of Biostatistics, University of Washington, 1982-1989
Affiliate Assoc. Professor, Dept. of Biostatistics, University of Washington, 1989-present
Senior Consultant, Axio Research Corporation, 1989-present
Owner, The Mountain-Whisper-Light Statistical Consulting, 1989-present

Other Appointments:

Consultant, NIH Study Section on Human Infertility, 1978
Consultant, Ford Foundation, Djakarta, Indonesia, 1971
Associate, Center for Studies in Demography and Ecology, University of Washington, 1976
Affiliate, Center for Health Services Research, University of Washington, 1977
Consultant, Science Advisory Board, EPA, 1985
Member, Hanford Health Effects Panel, 1986
Consultant, SBIR Review Panel, 1987
Consultant, World Bank, 1988

Honors

Distinguished Honorary Citizenship, Washington State, 1983
Co-recipient: Licht Award from the American College of Rehabilitation Medicine for excellence in Scientific Writing, 1993
Co-recipient: Best Research Paper award (physiatrist category) from the Phys. Med. and Rehabilitation Research Foundation and American Association of Phys. Med. and Rehabilitation, 1995

**Membership in Professional Organizations:**

American Statistical Association
Biometric Society

**Consulting**

*Examples of completed projects:*

Design and analysis of drug and treatment trials
Malpractice -- effects of cancer treatment delay
Accuracy of pap smears
Effectiveness of rehabilitation services
Evaluation of lens implants
Asbestos risk assessment
Racial discrimination -- develop and analyze database
Survey design, sample size, analysis
Neurobehavioral outcomes following head injury
Risk factors for relapse among physicians treated for substance abuse
Impact of ergonomic laws on ergonomic practices and injury rates
Diagnostic tests for cancer based on infrared spectrum of DNA
Spatial distribution of environmental contaminants and spatial sampling

**Research** (Principal Investigator of $2.5 million in grants and contracts):

Cancer risk from asbestos in drinking water
Pathways of community exposure to arsenic from a smelter
Cancer risk from phenoxy herbicides
Hospice use and cost in Western Washington
Adult respiratory distress syndrome -- epidemiology and survival
Treatment and referral patterns for cervical cancer
Auto exhaust and cancer

**Teaching**

Taught Biostatistics courses at the University of Washington for 15 years
Offer invited lectures on statistical consulting 2-3 times/year at the UW

## Research Papers in Refereed Journals

1 Batjer JD, Williamson LJ, Polissar L, Hamlin WB: Bacterial contamination of reagent water: Effect on selected laboratory tests. Am J Clin Path 71:319-25, 1979.

2 Smith DE, Davis S, Polissar L: The hospital cancer program: Its impact on cancer care. Am Surgeon 11:730-7, 1979.

3 Polissar L: The effect of migration on comparison of disease rates in geographic studies in the United States. Am J Epidemiol 111:175-82, 1980.

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