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DISTRIBUTIONS OF FAMILY HOSPITAL  
AND PHYSICIAN EXPENSES

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Martin Feldstein gave substantial advice. Francis Atorick of Aetna Life and Casualty and Richard Hanschu of Michigan Blue Cross Association generously contributed data resources and helpful discussions. The research reported here is part of the NBER's research project in health insurance. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

The paper develops frequency distribution of annual health expense for a variety of family compositions. The basic data resource was a sample of claims for a large group of federal employees in 1977. The primary data were compared in several aspects against three other sources of reference data on expenses by the non-aged population; the comparisons were reassuring.

The method of convolution is used to obtain family frequency distributions from the distribution for individual adults and children. This technique is necessary when the claims data do not record family composition. In consequence, the results may not be nationally representative of households which are relatively large or affected by unemployment. Aside from this special reservation, the experience of the non-elderly federal employee families seems to be a useful resource for policy analysis.

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Distributions of Family Hospital and  
Physician Expenses

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The purpose of this report is to develop and discuss some new frequency distributions of family health expenses. Such distributions, if nationally representative of non-aged, non-poor, households would be useful for evaluating proposals for new health insurance programs.

Ideally, these distributions would be obtained from a large sample of families, using insurance company and household records under the following conditions: the composition of each enrolled family is known; all families have the same insurance coverage that is extensive by current standards; there was no selection bias in the observed population. These ideal requirements cannot be met with any single available data resource. There are a variety of imperfect data resources, any of which should be used only with caution and after cross-checking for significant discrepancies.<sup>1/</sup>

In this report, expenditure distributions are developed from the claims experience of a large group of federal employees in 1977. Several characteristics of this data will be compared with other sources such as per capita spending computed at HEW, claims experience at Blue Cross-Blue Shield of Michigan, and claims experience of Metropolitan Life employees. The comparisons are rather reassuring.

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Some interesting questions about the impact of new insurance programs would require much more disaggregated detail than is attainable with present resources. For example, the sources of family income, education, age and occupation of members are likely to affect the responses of sub-populations to insurance changes. Also, health care supply conditions vary geographically and therefore consequences of insurance innovation will also vary with location. The present resources and analysis allow direct disaggregation only by family size, and are primarily relevant to aggregate budgetary and service demand consequences of insurance changes. <sup>2/</sup>

#### Sampled Population and Insurance Coverage

In 1977, there were approximately 862,000 persons insured under the high-option Indemnity Plan (Aetna Life and Casualty) for federal employees. The persons insured are either enrollees (employees and annuitants), spouses, or dependent children under age 19 or full-time students to age 23 or disabled children with no age limit.

Each enrollee represents a "contract." There were about 274,000 contracts headed by an enrollee under age 65. These contracts, containing about 452,000 adults and 277,000 children are the reference population for the ensuing analysis. The enrollees had a choice of several insurance plans, each having an experience-rated premium paid partly by the enrollee. The 1977 premium (including both employer and subscriber payments) for family coverage was \$960 per year for the Aetna plan, which was somewhat lower than the premium for the more popular Blue Cross-Blue Shield option. The BCBS plan has more complete "first-dollar" coverage than the Aetna, but the two are comparable in the coverage of large expenses. The possible selection bias is that Aetna families may expect to incur fewer moderate health care needs than the average federal employee family.

Virtually all health care expenses are covered in the Aetna plan except dentistry, routine checkups or well-baby care, eye glasses or eye examinations. The family is responsible for 20% of hospital room and board expenses after \$2000, 20% of all other hospital expenses, the first \$75 and then 20% of ambulatory care. Family copayment ends when \$10,000 of gross expense is exceeded. This is a clear instance of "catastrophic" coverage. Further general information on enrollment and coverage may be found in publications of the U.S. Civil Service Commission. (Annual Reports, booklet BRI 41-24, and Federal Fringe Benefit Facts, 1978)

#### Claims Experience

The Aetna company has prepared a 10% sample of all contracts with claims for occurrences in 1977. The resulting file contains the annual experience of each of 25,197 persons under age 65. The exact family composition of each claimant contract is unknown, as is commonly the case in insurance claim statistics. Therefore, the size distribution of expense for a particular family composition cannot be simply observed. Instead, each family composition must be synthesized from the individual distributions for adults and children. This procedure will be addressed in a later section.

The average annual covered expense appearing on claims was approximately \$279 per insured person. Persons not submitting claims may have had some expense. This average is only 5% lower than the experience of Blue Cross-Blue Shield of Michigan (BCBSM) with more than 2 million regular (non-aged) contracts in force. More specifically, for BCBSM the average claimed charges per person insured in 1977 were \$296. Health care prices in Michigan are slightly higher than the national average, and there are more

blue-collar worker families than in the federally employee population. This comparison is therefore somewhat reassuring about the national representativeness of the Aetna data.

The upper tail of the distribution of claimed expenses is a matter of great interest for current policy discussions. In Table I below, the Aetna and BCBSM results are compared in a gross fashion permitted by published data.

Table I  
Distribution of Contracts with Claims

Expense Category	Relative Frequency	
	<u>Aetna</u>	<u>BCBSM</u>
\$ 0 - 10,000	.9826	.9862
10 - 50,000	.0171	.0135
50,000 +	.0002	.0002

(Source for BCBSM: Blue Cross Association, Perspective, Spring, 1979, and private communication)

These data again do not suggest serious incompatibility between the reference population and Michigan families. Apparently, the Aetna group had relatively more large claims, but because of greater "first-dollar" coverage or other factors, the average expense for families in the lower category was higher in Michigan.

A second population with which the Aetna group may be compared is the population of employees of Metropolitan Life, whose headquarters is in New York City. The Metropolitan claims experience for 1965-1975 has been applied in policy analysis by the Congressional Budget Office. <sup>3/</sup>

Table II compares the upper tail of claimed expenses for Aetna federal employees and Metropolitan employees. The crudest comparison between the first and third columns shows a greater proportion of expenses

in the upper tail of the Aetna group. Partly, this is due to the increase in per capita hospital and physician expenses of 22% between 1975 and 1977. Also, the Metropolitan plan has more "first-dollar" coverage. After adjusting all Aetna claims proportionally for inflation, the two distributions are quite comparable.

Table II

Expenses in the Upper Tail of Contracts

<u>Limit Expense</u>	<u>Aetna, 1977</u>	<u>adjusted for inflation</u>	<u>Metropolitan 1975</u>
\$ 5,000	.398	.328	.284
10,000	.223	.169	.154
15,000	.140	.110	.092
50,000	.011	.011	NA

The size distribution of expenses for an individual is reported in Table III. Spouses have been omitted, but their average expense was only 4% greater than that of enrolled adults. All non-claiming adults were assumed to have \$34 in ambulatory medical expenses. This amount is derived from results of the Current Medicare Survey, a panel study using diaries of expense for individuals who do not meet a deductible on comprehensive ambulatory services. Children without claims were assumed to have \$40 in routine uncovered expense.

TABLE III: SIZE DISTRIBUTION OF EXPENSES FOR INDIVIDUALS

Expense Category	Enrolled Adult *		Child	
	Avg.	Freq.	Avg.	Freq.
\$0- 50	\$ 34	.5882	\$ 39	.7067
- 100	77	.0438	75	.0687
- 250	168	.1235	162	.1109
- 500	356	.0891	348	.0553
- 1,000	705	.0564	716	.0313
- 2,500	1602	.0524	1,514	.0194
- 5,000	3493	.0280	3,343	.0047
- 7,500	6003	.0078	6,029	.0011
-10,000	8712	.0041	8,639	.0004
-15,000	11757	.0037	12,592	.0006
-25,000	18763	.0022	18,824	.0003
-50,000	32229	.0007	35,484	.0003
50,000+	82746	.0000	80,077	.0000
Number of claimants in Sample:	12,365		10,151	
10% of covered persons:	27,400		27,758	
Mean Expense:	\$490		\$187	

\* under age 65



The mean results in Table III can be compared with official estimates of national per capita expense in 1977. For the national per capita expense in Table IV below, dentistry, eyeglasses and nursing home care have been eliminated, and the fiscal year rather than calendar year is available.

TABLE IV: MEAN EXPENSES PER PERSON, 1977

<u>Age</u>	<u>National</u>	<u>Aetna</u>
under 19	\$214	\$187 (-13%)
19-64	\$581	\$490 (-16%)

(Source for national data: R. Gibson and C. Fisher, "Age Differences in Health Care Spending, Fiscal Year 1977." Social Security Bulletin, January, 1979.)

The table shows, presumably, the net effect on the two populations of differences in geographic concentration, age, income, education, insurance coverage, health status or other factors. The apparent difference between the groups would be narrowed if an appropriate share of drugs and other health services (e.g., psychiatric) were deducted from the national means. In some previous investigations, federal employee group expenses have been said to overestimate national averages. The present analysis may have reversed this perception by using an age limit. It is noteworthy that the Michigan experience would also tend to fall short of the national averages in Table II. These findings suggest that private insurance data would tend to underestimate the experience of persons eligible for comprehensive Medicaid assistance.

Family Expenses

In the previous section I explained why family experience cannot be simply tabulated from claims records. In this section, family experience is estimated by the method of convolution. The method of convoluting independent random variables is as follows. Consider a two-person family, so that family expense,  $E_f$  is the sum of expense for individual 1 and individual 2.

$$E_f = E_1 + E_2$$

Then 
$$\text{Prob} \{E_f = X\} = \sum_{Z=0}^X \text{Prob} \{E_1 = Z\} \cdot \text{Prob} \{E_2 = X - Z\}$$

In the case of independent distributions, a family distribution for any particular composition is easily synthesized by a sequence of pairwise convolutions. There are, however, reservations that should be attached to the independence assumption. Contagious disease and accidents suggest a positive correlation among the expenses of family members. Also, conformity of decision-making in the family suggests a positive correlation. If we took a sample of individuals living alone and estimated family experience using the independence assumption, we would expect to underestimate the variance of family expense because of positive intra-family correlation. Our sample is not individuals living alone, so there is not necessarily a distorted result.

The problem of bias from the independence assumption is more acute the farther we depart from modal family size in the sample (which has a mean of 3.3 persons per contract). In the case of large families, it is quite possible that average family expense will be overestimated. There may be economies of scale in knowledge and treatment as in other areas of family life. Also, if there is a general association of larger family size with lower income this

would suggest reduced health expense per person.

Families with a composition close to the sample mode can be estimated with unknown but perhaps tolerable bias until better data are available. Tables Va through Vf below present a variety of family distributions synthesized from the Aetna individuals.

The hazards of the independence assumption have this implication for analysis of new insurance programs: effects on small, very large, or unemployed households are not confidently predicted by the Aetna federal employee experience. However, for medium-sized households in the non-elderly employed population, the Aetna data seem to be a valuable research resource.

Table Va

Expenditure Distribution: One Adult and One Child

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250	111	.65598	11%
- 500	386	.11771	17.9
- 1,000	719	.09529	28.2
- 2,500	1629	.07617	46.9
- 5,000	3568	.03275	64.5
- 7,500	6051	.00932	73.0
- 10,000	8755	.00458	79.0
- 15,000	11978	.00446	87.1
- 25,000	18896	.00249	94.1
- 50,000	33411	.00098	99.2
50,001 +	81420	<u>.00008</u>	100.2
		.99981	

Mean Expense = \$663

Table Vb

Expenditure Distribution: One Adult and Four Children

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250	235	.26884	5.6%
- 500	378	.22603	13.3
- 1,000	737	.25604	23.9
- 2,500	1718	.16661	49.5
- 5,000	3760	.04799	65.7
- 7,500	6131	.01500	74.2
- 10,000	8862	.00632	79.0
- 15,000	12453	.00676	86.5
- 25,000	19249	.00353	92.6
- 50,000	34934	.00188	98.4
50,001 +	80892	<u>.00021</u>	100
		.99921	

Mean Expense = \$1117

Table Vc

Expenditure Distribution: Two Adults

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250	111	.55560	6.8%
- 500	386	.12787	12.3
- 1,000	714	.11516	21.4
- 2,500	1658	.10767	41.1
- 5,000	3600	.05326	54.1
- 7,500	5998	.01787	66.0
- 10,000	8756	.00863	74.3
- 15,000	11906	.00788	84.7
- 25,000	18934	.00458	94.3
- 50,000	32582	.00141	99.4
50,001 +	81981	<u>.00008</u>	100
		1.00001	

Mean Expense = \$ 904

Table Vd

Expenditure Distribution: Two Adults and One Child

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250	156	.45479	6.1%
- 500	398	.15594	11.5
- 1,000	737	.15232	21.2
- 2,500	1693	.13425	40.9
- 5,000	3669	.05765	59.2
- 7,500	6034	.02007	69.7
- 10,000	8796	.00930	76.8
- 15,000	12059	.00871	85.9
- 25,000	19060	.00497	94.1
- 50,000	33328	.00171	99.1
50,001 +	81363	<u>.00013</u>	100
		.99984	

Mean Expense = \$ 1154

Table Ve

Expenditure Distribution: Two Adults and Two Children

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250	179	.26753	3.6%
- 500	355	.25989	10.6
- 1,000	748	.19652	21.6
- 2,500	1723	.16369	42.9
- 5,000	3732	.06245	60.4
- 7,500	6066	.02240	70.6
- 10,000	8826	.01002	77.3
- 15,000	12192	.00958	86.1
- 25,000	19170	.00535	93.8
- 50,000	33852	.00202	99.0
50,001 +	81109	<u>.00017</u>	100
		.99962	

Mean Expense = \$ 1328



Table Vf

Expenditure Distribution: Two Adults and Four Children

<u>Expense Interval</u>	<u>Average</u>	<u>Relative Frequency</u>	<u>Cumulative Share of Expenses</u>
\$0 - 250		0	0
- 500	358	.37308	8.0%
- 1,000	788	.26385	20.4
- 2,500	1784	.23046	44.9
- 5,000	3856	.07233	61.6
- 7,500	6141	.02750	71.6
- 10,000	8897	.01165	77.8
- 15,000	12447	.01132	86.2
- 25,000	19405	.00616	93.3
- 50,000	34681	.00263	99.5
50,001 +	80952	<u>.00025</u>	100.7
		.99923	

Mean Expense = \$1675

## NOTES

1/

During the 1980's more ideal data files should become available from a major project of the National Center for Health Statistics. Results of the Health Insurance Experiment conducted by the <sup>Round</sup> Corporation will also be forthcoming and should clarify the importance of selection bias in insured groups.

2/

Indirect methods of disaggregated analysis are possible. For example, experimental results or other studies may yield reliable models of the effect of income and other variables on health care demands, independent of insurance coverage. Then the reported distributions in this paper could be used to synthesize distributions for particular subpopulations.

3/

See U.S. Congressional Budget Office, "Catastrophic Health Insurance," Budget Issue Paper (January, 1977). Analysis of the Metropolitan claims was performed under contract by Gordon Trapnell who kindly provided the data presented in this paper.