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Scholarly Debate

The Rand Health Insurance Study: A Summary Critique

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The Rand Health Insurance Study (HIS) is the first formal social experiment comparing economies and health outcomes of different health insurance plans. It was initiated by the Rand Corporation in 1974, is now in its summary stage, and is expected to conclude in 1986. The first report of results compared the effects of cost sharing and free care upon health care utilization in fee-for-service (FFS) practice.[1] A subsequent report extended a portion of the same data and compared them with data from an HMO.[2] The HMO studied was Group Health Cooperative of Puget Sound (GHC).

These reports, given visibility and prestige by publication in the *New England Journal of Medicine,* by Rand sponsorship and by the large size of the supporting grant (an inflation-adjusted cost through fiscal 1985 in excess of $127 million[3]), have received considerable attention. They are exerting significant influence on public and legislative opinion to accelerate the rapid change occurring in the health care system. Hence, the problems we discuss here are of particular import.

Rand has purported to show that demonstration participants randomly assigned to fee-for-service plans with high levels of coinsurance or to an HMO, have significantly lower health care expenditures than participants assigned to a free care fee-for-service plan. They have presented no evidence that would suggest that participant health status was generally or seriously compromised by the various financing options in their study.

We question whether the differences in health care expenditures and hospital utilization between health insurance plans claimed by Rand[1,2] have, in fact, been shown. The problems that we see with the Rand reports include (1) apparent bias in presentation of study results; (2) technical problems of experimental design and statistical interpretation; (3) failure to discuss pre- versus per-experimental data comparisons that weaken their reported results; (4) insufficiency of information in the Rand reports and cited references to support their conclusions and recommendations; (5) inconsistencies within and between the Rand reports and their documenting citations; and (6) more than 4 years after publication of the first report,[1] it was still not possible for out-

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side researchers to obtain documentation of HIS reports, either from Rand or the HIS federal sponsoring agency.

In this critique we summarize some of these problems. A complete report, including several technical issues that are not discussed here, is available upon request.[4] Broadly speaking, the latter issues concern apparent t-statistic inflation and understatement of econometric model prediction variance.[5–7] They resulted in overstatements of the level of statistical "significance" in expenditure differences between the comparison insurance plans.

Apparent Bias

Aspects of the HIS were presented in an ostensibly biased manner. Misinterpretations reflecting this bias have been widely repeated in news coverage, both general and professional, and in professional citations.[8,9]

As an example of this bias, the abstract of the HMO paper,[2] although conveying the summary interpretation that the "style of medicine in HMOs" had been found "markedly less 'hospital intensive' and, consequently, less expensive than in FFS (fee-for-service) practice," failed to acknowledge that no such difference was found between the GHC-E (experimental) and copay FFS plans. Indeed, it failed to even mention that the study had included copay FFS plans, although there were three copay plans and they comprised 65% of all quasi-randomized[10] FFS subjects and 33% of the total quasi-randomized sample employed in the experiment. Although the text acknowledged that copay FFS plans and the HMO did not significantly differ in either hospitalization or expenditure, it did so with distinctly subordinate emphasis, while according, on the other hand, special emphasis to the fact that no appreciable difference was found in these respects between GHC-E ("experimental") and GHC-C ("control").

Aspects of Rand's experimental design and analysis also inappropriately de-emphasized the economy of copay FFS relative to GHC.[4]

Low-Risk Selection of GHC "Controls"

The central importance of the Rand HMO Study[2,8] was said to be that, through random assignment of study subjects, it eliminated the argument that HMO personal health care expenditures were lower than those in FFS due to self-selection of relatively healthy people into the HMOs.[11] Observing that GHC-E and GHC-C were similar with respect to hospitalization rates and total annual per-person expenditure, Rand[2] surmised that GHC-E accurately represented the GHC population and that the latter was representative of the general Seattle area population. We question, however, both of these inferences.

That GHC-E differed qualitatively from GHC-C in its service demands is suggested by its relatively high demand for services from extra-GHC sources (Table 3 of reference 2). GHC-E, as compared with GHC-C, by Cochran's t, averaged 75% more ambulatory face-to-face medical visits per person outside GHC ($t = 2.12$, $P < 0.05$); 600% as many visits per person to allied health practitioners such as chiropractors, podiatrists, and Christian Science practitioners ($t = 4.47$, $P < 0.001$); and had total per-person outside expenditures 420% greater ($t = 3.45$, $P < 0.001$).[2,4]

GHC-C patients averaged a 24% higher family income ($t = 4.75$, $P < 0.001$) and had more education ($t = 8.77$, $P < 0.001$) than GHC-E[4,12] patients. Also, GHC-C enrollees were significantly older than GHC-E enrollees (26.6 ± 0.60 versus 24.6 ± 0.45 years of age, $t = 2.67$, $P < 0.01$).[4,12] With its older age profile GHC-C would be expected to have higher medical expenditures than GHC-E.[13] This did not occur. Rather, GHC-C averaged a somewhat lower albeit not significantly lower hospitalization rate and duration of hospital stay, consistent with the suggestion that it comprised a self-selected, relatively low-risk population.

We see support neither for Rand's contention that their ". . . results show minor and generally insignificant differences between the two GHC groups, suggesting that results from noncontrolled studies may not be seriously contaminated by selection effects,"[2] nor for Enthoven's contention that "At the level of practical policy decisions . . . the conclusion is now well established: the lower cost at GHC and organizations like it cannot be explained by differences in the population that it treats."[8] Indeed, the unpublished appendix[12] to the HMO report[2] contradicts its parent report: ". . . the GHC Controls differ significantly from the GHC experimentals in both individual and family characteristics ($P < 0.001$). Because the Control group was not randomly assigned . . . these differences almost certainly reflect true differences between people who select GHC and the remainder of the Seattle population."[12]

Expenditure Versus Cost

Rand, Enthoven[8] and, consequently, the press have ignored the important distinction between expenditures made by a third party for services delivered and the actual cost to the consumer and/or his sponsor for services received. A difference in services delivered does not necessarily translate into a difference in consumer costs; benefits purchased and benefits received are not necessarily the same.[14] To our knowledge, the organizational, administrative, and marketing expenses of HMOs have been nowhere formally quantified,[15,16] although they clearly consume an ample portion of the health care dollars that HMOs receive.[14] Of 253 companies contacted in a recent survey, 26% reported that HMOs were at least as expensive for them as conventional insurance whereas only 13% found HMOs cheaper.[17]

We estimate that consumers having the age and sex characteristics of Rand's study participants[12] could find the actual cost of membership in GHC[18] considerably greater than the cost of membership in comprehensive Blue Cross of Washington and Alaska (BC) indemnity plans,[19] which, adjusted for inflation, provide coverage categorically comparable to that provided by Rand's copay plans[2] (the average is about 80% greater, range 44–151% greater for $200, $500, and $1,000 deductible plans, 20% coinsurance on the first $2,500 in 1983 dollars). We assumed a normal distribution by age for enrollees; this is conservative, since the actual age distribution is weighted heavily towards youth, and BC premiums increase with adult age, whereas GHC charges a single adult rate.[18,19] We also assumed an age-specific pregnancy rate and distribution of children to families equal to the national average.[20]

Total costs, copayments included, also appear to be less, certainly not more, in copay FFS than in GHC-E if one assumes that copayment costs were normally distributed (this is conservative since they are more nearly log normal) and if one uses as the basis for calculations the expenditures and divisions thereof reported by Rand.[1,2,12] Beyond such estimates, moreover, GHC members may have a higher real cost than BC-FFS enrollees because of relatively costly GHC coverage exclusions. Such exclusions were not mentioned by Rand. GHC provides some services that BC comprehensive plans do not provide; these tend to be comparatively low-cost services, e.g., well-baby care, periodic "health monitoring exams," routine eye examinations, counseling on sexual and infertility problems, and classes for stress management, smoking cessation, and food management. GHC, on the other hand, is more restrictive than BC in important ways. Thus, it provides less coverage for skilled nursing and makes no provisions for inpatient care of nervous and mental conditions. It excludes coverage for blood, "outpatient mental health drugs," all prosthetic devices (including artificial eyes and "members"), abortion, drug addiction treatment (except counseling), transplants (except kidney, cornea, or bone marrow) including donor costs,

TABLE 1. Pre-Versus Per-Experiment Utilization of Medical Services in the HMO Study*

	Average Number of M.D. Visits Per Year			
	Free-FFS	Copay-FFS	GHC-E	
	Number Visits/Person			GHC
Pre (during year before starting the experiment)†	3.8 (0.28)	3.6 (0.21)	4.0 (0.17)	4.5 (0.2)
Per (during the experiment)[2]	4.2 (0.25)	3.2 (0.35)	4.3 (0.14)	4.7 (0.1)
	Persons Hospitalized One or More Times Per Year			
	Plans of Common Origin			
	Free-FFS	Copay-FFS	GHC-E	
	(Percent)			GHC-C
Pre (during year before starting the experiment)†	10.3 (1.48)	10.0 (1.08)	10.5 (0.92)	9.4 (1.09)
Per (during the experiment)[2]	11.1 (1.51)	8.4 (0.99)	7.1 (0.67)	6.4 (1.01)

* The figures in parentheses are SEM.

† From Table A-1 of Manning et al.[12] Although that Table does not explicitly state that these data are for the year preceeding enrollment in the study, Manning[22] has confirmed that that is the case.

all durable medical equipment, and outpatient dressings and supplies, including diabetic supplies. BC, but not GHC, has a 30-day waiting period after the effective date for all coverage except for accidents. GHC, however, has a 12-month waiting period for nonexcluded preexisting conditions, compared with only 6 months at BC.[18,19]

Rand[21] wrote that they could quantify "the expected savings that a randomly chosen current user of the fee-for-service system would experience if that person were to enroll in GHC." But Rand has reported,[2] and has studied,[22] only third party direct medical expenditures, not costs to consumers, which would also include the aforementioned administrative and marketing expenses. This important distinction should be more formally made.

Pre- and Per-Experimental Comparisons

It is meaningful to observe how the individual study groups changed from their previous condition during the course of the experiment as well as to compare their per-experimental characteristics. Ideally, the conclusions drawn from these two approaches to the data should be reinforcing. Rand[1,2] has reported only their per-experimental observations.

For the HMO report, we have superimposed and compared the figures for medical service utilization during the experimental period[2] with those for the year prior to commencement of the study for the same people who would later comprise the study groups[12] (see our Table 1). Contrary to the implication of the Rand reports,[1,2] neither the free nor the copay FFS plans showed significant difference between the pre- and per-experimental periods.

Also, Manning et al.[2] interpreted their experimental data to suggest that a previously high hospitalization rate characteristic of the general FFS population was restrained by GHC-E during the course of the experiment to conform to a lower hospitalization rate characteristic of HMOs as represented by

TABLE 2. Comparative Percentage of All Persons Invited to Enroll, and Who Actually Enrolled in Plans of the HMO Study[2] Who Were Receiving Aid to Families With Dependent Children (AFDC) or Public Health Insurance (PHI)[12]

Plan	Percentage Invited to Enroll		Percentage Actually Enrolled	
	PHI	AFDC	PHI	AFDC
Plans assigned from a common pool				
Free fee-for-service	9.0	11.5	9.5	12.1
Copay fee-for-service	7.1	7.1	5.1	6.1
GHC* experimental	4.5	4.9	4.7	5.2
(Chi square† for difference among the three above plans, df = 2)	(6.04)†	(9.59)§	(5.71)	(9.60)§
GHC* "control"	2.2	2.2	2.5	2.2

* GHC = Group Health Cooperative of Puget Sound.

† We divided chi square by 2.5, average family size[2], to categorically adjust for intrafamily correlation. This is much more conservative than dividing by 1.36 as suggested by Rand.[27]

‡ $P < 0.05$ (two-tailed); §$P < 0.01$ (two-tailed).

GHC-C. Coincident with this, they reported that the rate of GHC-E outpatient visits to physicians increased to conform to the somewhat higher ambulatory visit rate ostensibly characteristic of HMOs as represented by GHC-C. Our comparison of pre- and per-experimental data shows that this clearly was not the case. GHC-C and GHC-E had similar rates before the experiment, and their rates underwent similar changes during the experimental period, as if responding in unison to some policy and/or practice change initiated about the time the experiment began within that particular HMO, such that they ended the experiment, as they had begun, with similar hospitalization and physician visit rates. These observations suggest that the phenomena under study are more complex, and/or that the data available may be less useful, than they seem.

Differential Assignment to Plans

In the Seattle site, where the HMO study was conducted (we do not have access to complementary data for the other sites), a relatively large proportion of very low income people were invited to enroll in, and did participate in, the free FFS plan.[12] Our Table 2 shows that the proportion of persons who were on public health insurance or AFDC (Aid to Families with Dependent Children) programs was at least twice as great among those who were invited to enroll in, or who actually enrolled in, the free FFS plan as among those who were invited to enroll in, or who actually enrolled in, GHC-E. This favored an overstatement of the relative medical service demands made on the free FFS plan, thus biasing towards Rand's reported results.

Other Seattle data also favor an overestimation of the relative demands upon the free FFS plan.[12] Of all persons of common origin who were assigned to a study plan and invited to participate, only 5% refused to enter the free FFS plan, compared with 16 to 21% refusing the other plans. The proportion who voluntarily withdrew from participation during the course of the experiment was 20 to 50 times lower in the free FFS plan than in the other plans, differences that are highly significant statistically.[12,23]

Although GHC-E was "free" (actually it involved modest cost-participation),[4] people just as often refused offers to join GHC-E as offers to join copay FFS plans. Once enrolled, participants voluntarily dropped out of

TABLE 3. Comparative Percentages by Plan of Persons Refusing Invitations to Enroll in Study Plans and Voluntarily Withdrawing From Plans of the HMO Study*[2,12]

	Invitations to Join Declined (%)	Enrollees Voluntarily Drop Out (%)
Plans of common origin		
Free fee-for-service	5.0	0.2
Copay fee-for-service	19.6	9.6†
GHC experimental	21.2	4.4†
GHC "control"	16.5	11.9

* All differences from free FFS are highly significant.
† GHC-E is significantly different from both GHC-C and Copay FFS. Brooke et al.[23] gave voluntary withdrawals separately for the individual copay plans for persons 14–61 yr of age. As a factor of the free plan percentage they were: 10.9 for the 25% and 50% copay plans, 15.6 for the individual deductible plan, 28.3 for the catastrophic plan. These factors compare above with 19.1 for GHC-E, 41.3 for Copay FFS and 51.2 for GHC-C.

GHC-E at a rate similar to, or nominally higher than, that of all copay plans except the 95% coinsurance plan. The voluntary dropout rate of the latter plan, although higher than that of GHC-E, was nominally lower than that of GHC-C. These figures, shown in our Table 3, speak to the issue of the perception of the quality and accessibility of care. They recall a recent study[9] in which a significantly higher proportion of HMO than FFS patients were dissatisfied with the amount of time required to schedule an appointment or to reach a physician by telephone. Such perceptions, accurate or not, may ultimately be reflected in the comparative economies of different types of health care plans.

Despite such differences, Rand[23] judged there to be no selection bias between free and copay FFS plans for people 14 to 61 years of age. Like Relman,[24] however, we note that Rand's comparison excluded ". . . the very young, the elderly, or the disabled . . .", and we are ". . . disappointed to find that only a few limited measures of health were used in these comparisons." Rand also judged there to be no selection bias in the HMO study,[2,12] but the indices of health status underlying that judgment were even more limited than the aforementioned.

Enrollees in copay plans of the HMO study[2] averaged 26.1 ± 0.59 years of age compared with 24.6 ± 0.45 years for those in the GHC-E experimental plan[12] (mean ± SEM), an apparently significant difference (Cochran's $t = 2.02$, $P < 0.05$, two-tailed[4]). Thus a higher proportion of copay than HMO enrollees should have been in older age categories that account for high proportions of total medical costs.[13]

Interaction and Confounding

In attempting to explain a strong reversal from expected plan relationships in outpatient mental health expenditures, Rand said, "We believe that one source of this anomoly is the fact that the plans are somewhat confounded with site."[25,26] It was speculated that site-to-site differences in the proportion of mental health care obtained from formal and informal providers caused their apparently anomolous results. The problem of confounding, however, was not mentioned by Rand in either of the initial reports[1,2] or their sequelae.[27–29] Newhouse et al.[29] dismissed such departures from expectation as "random fluctuations," which they could be. If, however, the mental health data were confounded with site as suggested in the more recent report,[26] the total expenditure and hospitalization data, of which they are a part, could be as well.

Certainly the study sites differed in many ways that could contribute to confounding. Thus, the number of primary care physicians per 100,000 population varied from 30 to 50; the number of days spent on the average waiting for a new appointment with a primary care physician varied from 2 to 25; blacks varied from 1 to 13% of the population; and the percent of persons over age 24 with less than 5 years of education varied by more than a factor of two.[29] Median in-

come varied by 19% across sites[29] and, since the maximum deductible expenditure in the copay plans was linked to income level, this alone could importantly bias response by plan.[30] We calculate that the proportion of the initial sample that actually enrolled in the study differed significantly by site (see reference 25, Tables 1, 2). Variations in plan sample size between sites were quite ample to emphasize such differences, the relative difference between sample size of compared plans being directionally opposite from one site to another and, in absolute terms, varying from a factor of 2.1 to 3.5 or more.[1,26]

Hospitalization

Although not noted by the published reports[1,2] or by Newhouse et al.,[29] the inpatient data were limited in such manner as to necessitate several accomodations in data processing that diminish the credence that one can give the putative plan differences in hospitalization rates and expenditures. Thus, in estimating the two inpatient equations, which account for nearly 60% of total expenditures:[27] (1) All covariates other than "female adult" and "child" were ". . . deleted because the data did not exhibit a linear response on the main effects only specification." (2) Even for the covariates retained, "The data were too thin to estimate the necessary interactions." (3) All 9 site-years of data ". . . were pooled because the estimates for single site-years were very imprecise."

Although Rand considered there to be highly significant differences between plans in the proportion of enrollees hospitalized one or more times in a year, the maximum overall differences observed between plans of common origin were only three to four percentage points.[1,2] Although these apparent plan differences are important if real, formidable statistical problems are encountered in the attempt to specify the significance of such small and irregularly distributed differences in such a highly variable population. Included among these problems are those just mentioned; the aforementioned possibility of selection bias; the location of the specified proportions in the extreme tail of the stochastic distribution where the probit transformation employed is most sensitive to departures from normality and therefore least precise; and the questionable adequacy of the methods used post-facto to compensate for intraperson-interyear and intrafamily correlation.[4]

Given the uneven distribution of sample sizes to the ultimate plan-site study units in the cost-participation report,[1,26] 5% of these units would expect fewer than four people to be hospitalized per year, 23% fewer than 6, and the median only 14–19. Although no details are given, it seems obvious that the variation in probability of hospitalization from one site-plan unit to another, and within the same unit from one year to the next, was substantial. One multiple person accident or illness within a single family could effect a change in the proportion of persons hospitalized in some site-plan units greater than the maximum overall difference reported between free care and a copay plan.[1]

The magnitude of year-to-year variation in probability of hospital admission for individual plans within a given site can be estimated by comparing Table 5 of Newhouse et al.[1] with Table 1 of Manning et al.,[2] since about two thirds of the person-years for the plans in the latter table were also represented in the former. Assume that the all-site average annual hospital admission probabilities given by Newhouse et al.[1] were reasonably descriptive of the first 2 years for the Seattle site, as they should have been. Then, it may be estimated that the proportion of persons hospitalized during the third year for the various individual plans in Seattle had to vary from about one third less than that during the first 2 years to about one third more in order to result in the proportional hospitalization rates quoted in the HMO report.[2] That is, the year-to-year variation in proportion of persons hospitalized appears to

have been similar to the maximum difference reported between plans.

Implications

One of the most fundamental principles of the scientific endeavor is the principle that the results of a scientific investigation and the methodology used to obtain and analyze them shall be made publically and readily available in a timely manner, and in sufficient detail to support independent assessments of the authors' interpretations and to guide attempts at replication. At the time of this writing, over four years after Rand's initial report Rand has neither told in adequate detail how their results were derived nor given sufficient data to support such independent assessment or replication. When, as in this instance, attempted replication is unlikely because of the uniqueness and/or great expense of the research, the importance of the issue of public verifiability is greatly enhanced. Moreover, adherence to this fundamental principle of science takes on an added dimension of importance when the results, as in this case, are so readily interpreted in terms of public policy.††

Although Rand's hypotheses about the relative level of utilization of health care services under different modes of funding may eventually prove correct, they have not yet been shown to be correct. In data in which 1% of individuals may account for 28% of all expenditures, eight to ten percent may account for over 56% of total expenditures, the coefficient of variation for expenditures ranges from 200 to over 600%,[1,2] and the retransformation adjustments used are plan-specific and may alter reported results by over 200%,[27] the significance of apparent 25% differences between plans is difficult to formally establish. Likewise, apparent differences between insurance plans in hospitalization rates are difficult to establish statistically when they are similar in size to the year-to-year within-plan differences at a given site and when potential interaction and confounding cannot be fully specified.

Convincing support for Rand's hypotheses has not been put forth. The data reported contain a message that, to us, differs in important respect from Rand's published conclusions. Moreover, the acceptability of such data and information as has been published is diminished by the problems that we report here and elsewhere.[4] Yet, for such a policy-sensitive project, the cost of inadequate oversight and review‡‡ in terms of misdirected health policy, as well as the integrity of the scientific process and, possibly, human life and suffering may be immense.

Key words: health insurance experiment; cost-sharing; health care demand; HMO cost savings; health care costs; fee-for-service expenditures.

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†† While this manuscript was under review, Rand released a portion of the data through the National Technical Information Service. Full details on Rand's statistical methodology are yet inaccessible.

‡‡ The Adequacy of HIS review was recently emphasized in interviews given Medical World News (September 22, 1986, p. 12). However, upon query from the authors of this manuscript, the HHS project officer indicated that review within the government had been largely verbal, that no accessible written records of review exist, and that reliance had been placed upon the approval in review that was implied by the acceptance of HIS reports for publication in refereed journals. Upon similar query from the authors, the Rand Corporation reiterated that review was ample but declined to give details other than to emphasize that reports had been accepted by refereed journals.

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