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Title: A STUDY OF PHYSICIAN ACCEPTANCE OF A PRESCRIPTION PHARMACEUTICAL INNOVATION WITHIN A SELECTED OREGON COMMUNITY

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An investigation concerning the acceptance of a new, legend drug product was conducted within a community of 15,000 population. Twenty-eight physicians within the community were chosen for evaluation relative to acceptance of the new drug product.

Data were obtained by means of a prescription audit of nine retail pharmacies in the community. The time period of the audit consisted of three months prior, and nine months subsequent, to the introduction of the new drug product.

A descriptive analysis of the selected pharmaceutical market indicated a seasonal variation in utilization of the class of drug products to which the new drug product belonged. A high degree of substitutability was also indicated for drug products within the special class.

A rank-order analysis indicated physician general prescribing frequency and physician class prescribing frequency were positively correlated.

Definitions of acceptance of the new drug product were constructed by means of objective criteria. These criteria were implemented by utilizing physician prescribing records, market share information, and a linear, least squares regression equation.

Certain physician characteristics were found to be positively correlated with early acceptance of the new drug product. These characteristics pertained to class prescribing frequency, general prescribing frequency, and medical school alma mater location.

Pharmacists within the community were selected for evaluation as an alternate source of market information. A mail questionnaire was constructed and from its responses eight physician classifications were established. Six of the classifications were positively correlated with early acceptance of the new drug product. The strengths of correlation of two questionnaire classifications were equal to the strongest correlation achieved using prescription audit data.

A Study of Physician Acceptance of a Prescription Pharmaceutical Innovation within a Selected Oregon Community

by

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INTRODUCTION

The United States' economy is characterized by economic behavior among firms which places an extreme emphasis on new product development. In 1960, total expenditures by all firms for new product development were estimated to be $10 billion, and are projected to be $20 billion by 1970 (16, p. 2). One source has defined the importance of new products to be such that firms must "innovate or perish" (15, p. 14). The following statement by Joseph Schumpeter offers a concise insight into the importance of innovation:

> Innovation is the outstanding fact in the economic history of capitalistic society or in what is purely economic in history, and also is largely responsible for most of what we attribute to other factors (17, p. 86).

This view has come to be the focus of what is defined as the new concept in marketing.

New products are introduced into the market economy with two primary risks: (a) the risk of initial market rejection; and (b) the risk of an insufficiently long life cycle if accepted. Currently, about 90.0 percent of all new products introduced fail within four years (18).

The importance of new product development and acceptance to the pharmaceutical industry is perhaps greater than in the economy

as a whole. Both aspects of new product risk appear to be greater within the pharmaceutical industry. Industry sources have estimated that only one product in 5,000 tested for use has marketing applicability, and only one product in ten achieves even moderate success (11). The second risk factor is emphasized by the assertion that life cycles as short as two years may be characteristic of many drug products (19, p. 86). Given these factors, a cursory examination of the pharmaceutical industry's economic environment may be appropriate to better understanding its concern with new products.

The demand for a prescription drug product is a derived demand, originating from an incidence of disease or from preventive therapy. The effective use of a drug may reduce the incidence of disease for which it is indicated, thus reducing potential demand for it. Also, since the indications for use of a new drug product are limited and roughly constant (pneumonia, polio, diabetes), demand is traditionally viewed as being inelastic in nature (3). Further, the actual consumer-patient seldom excercises any choice in the selection of a prescription drug product. Physicians act as purchasing agents for the ultimate consumer and select the appropriate drug for a course of treatment.

Both demand factors, the potential for use of drug products and the physician's role, function to increase marketing risk for a specific drug product. This is particularly true for products which are similar in therapeutic intent and which comply with minimum required

standards. Because the incidence of disease conditions is beyond a pharmaceutical firm's control, the physician's role is left as the critical, alterable factor in a new drug product's success.

Efforts of pharmaceutical firms to reduce the risk resulting from the physician's role include the development of more effective drugs for the physician's consideration. "Competition in creativity," one form of non-price competition, has become a major form of competition in the industry (9). This view is supported by observing the increase in pharmaceutical industry research and development expenditures from $60 million in 1950 to $450 million in 1967 (13, p. 39).

Efforts taken to reduce risk in the pharmaceutical industry include the extensive promotion of drug products to physicians. Once a pharmaceutical product has reached the market place, promotional expenditures are among the highest of all industries (7, p. 460). These promotional expenditures are selective because physicians are limited in number as well as professionally segmented.

The thrust of pharmaceutical promotion is dominated by professional service representatives, or detail men, who are responsible for over one-half, or 54.5 percent, of total promotional costs in the industry. The remaining promotional techniques in order of importance are direct-mail advertising (12.6 percent), medical journal advertising (12.1 percent), free drug samples (8.2 percent), and

other miscellaneous activities (12.7 percent) (20, p. 5). One source has estimated that pharmaceutical industry promotional expenditures amount to between one-fourth and one-third of total sales, an estimate which represented between $600 and $800 million in a recent year (5, p. 35). Conduct of this type has resulted in charges that the pharmaceutical industry overwhelms physicians and overprices drugs (6). Thus, to pharmaceutical firms and drug product consumers, the incentives for effective allocation of resources are obvious.

Legislative constraints also affect new drug product introduction and may function either to increase or decrease marketing indeterminancy. The patent system, administered by the United States Government Patent Office, issues grants giving an inventor the right to exclude all others from making, selling, or using his invention for a period of 17 years. The patent system has been credited with ". . . the development of numerous drugs vital to our increased life span" (14, p. 44). Patents obtained through the system are extensively used by the pharmaceutical industry to pursue extensive research, thereby gaining market power through market exclusion, and reducing marketing risk. It has been suggested that new drug research and development would be seriously restricted by any relaxation of the patent system (12).

Another legislative system which minimizes risk in marketing similar products is the trademark system. This system, administered

through the Lanham Act of 1947, allows a manufacturer to identify his products and distinguish them from those sold by others. The primary function of a trademark is to distinguish one person's products from those of another; but a trademark may also be used to assure purchasers (physicians) that the quality of products (drugs) bearing the trademark remains constant. The trademark, manifested through the use of a tradename, serves as the focus for pharmaceutical industry communications intended to stimulate and sustain demand for the product. Virtually all new drug products are assigned a tradename and promoted by reference to the tradename.

Marketing risk in the pharmaceutical industry is also affected by federal and state legislation. The Federal Food, Drug, and Cosmetic Act of 1938 was enacted "...to prohibit the movement in interstate commerce of adulterated and misbranded food, drugs, devices, and cosmetics, and for other purposes" (10, p. 81). In 1952, the Durham-Humphrey Amendments established a class of drugs, known as legend drugs[1], which may be obtained only through a physician's prescription. In 1962, Congress enacted the Harris-Kefauver Amendments to the Federal Food, Drug, and Cosmetic Act of 1938. The 1962 amendments added the requirement that a new

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[1] The term "drug product" will be used synonymously with "legend drug product" in subsequent portions of this study.

legend drug product must furnish proof of therapeutic efficacy, as well as safety. This requirement has increased the risk involved in new drug marketing, as New Drug Application (NDA) approvals have declined while research and development expenditures have increased (13, p. 42).

At the state level, statutory codes often make adulteration of drugs, or selling of adulterated drugs, a criminal offense. Few states in their pharmacy laws deal with substitution, a procedure whereby a pharmacist may substitute a different drug product than indicated by a physician's prescription. There is a tendency, however, for new state drug laws to declare that substitution of a different "brand" of medicine than requested is an offense (13, p. 48). Recent amendments to the Federal Food, Drug, and Cosmetic Act of 1938 have been interpreted to indicate that substitution causes a drug to be adulterated. As a result, substitution is implicitly restricted in all states. The mechanisms whereby substitution is prevented must be regarded as enhancing the differentiation of otherwise similar drug products, and possibly minimizing marketing risk.

Institutional factors must be viewed as being ambiguous in effect. The effects of increasing affluence, increasing consumer knowledge, changing consumer expectations, and changing societal commitments may be posited to have an effect on new drug product marketing, but have not been explored.

In summary, a new drug product is developed and its acceptance is generated within a unique market environment. Its uniqueness is governed by economic, personal, legislative, and institutional factors. The variety and impact of variables affecting development and acceptance of new drug products, and the achievement of a maximum impact of marketing effort are therefore of critical importance to a pharmaceutical firm for its continued survival. Given these fundamental relationships, investigational research directed to the area of new drug product acceptance is of value.

Although the importance of new product acceptance, particularly a legend drug product, is basic to pharmaceutical firms, a literature search revealed a dearth of information. Published literature on the subject is fragmented and unorganized. Published investigational studies concerning physician acceptance of a new legend drug product have been contributed primarily by sociologists pursuing diffusion research. It is quite probable, however, that pharmaceutical firms have conducted similar unpublished studies for confidential marketing purposes.

Caplow (1952) studied the influence of opinion leaders in the diffusion of drug products among physicians (1). The results of the study were inconclusive and were followed by the classic study of Medical Innovation at the Columbia Bureau of Applied Social Research (2). The study was concerned with diffusion of a new, legend

drug product into four contiguous communities ranging from 30,000 to 110,000 population, and containing a total of 360 physicians. Data were obtained by interviews with approximately one-third of the physicians and additional data were obtained from a random sampling of prescriptions dispensed by retail pharmacies.

The Columbia study asserted that rate of a physician's acceptance of a new drug product was primarily a function of the physician's risk involvement. Based on this assumption, significant correlations were shown to exist between certain physician characteristics and rate of acceptance of the new drug. The physician variables with significant positive correlations included age, specialty, volume of prescribing within the family of drug products, medical school alma mater location, and social integration of physicians. The inference has been commonly made that these correlations may be readily applied to marketing new products generally, and new drug products particularly (7).

A later study conducted in a very large metropolitan community and among a sample of 933 physicians in the community failed to confirm the general inferences stated by the Columbia study (23). The failure of these results to validate previous research was suggested by Winick to be primarily a consequence of the larger population size involved in the latter study (23).

If results obtained from larger populations of varying size are

not comparable, there is a need to determine whether any inferences concerning physician acceptance of a new drug product may be generalized to smaller communities. In order to further clarify the contradictory results, investigation of the acceptance of new, legend drug products into small communities is necessary.

A further limitation of the Columbia study was the definition of physician prescribing frequency utilized. A test correlation was conducted between rate of acceptance of the new, legend drug product, and frequency of prescribing for the family of drug products to which the new drug product belonged. In analyzing the data, however, the terminology "volume of prescribing for the family of drugs" was used synonomously with "total volume of prescribing" (2, p. 40). On logical grounds alone, the fallacy of division would suggest the terms cannot be used interchangeably. Further, if achievement of maximum impact of marketing effort is to be based upon the results of similar types of research, precise and accurate terminology must be utilized.

There is paucity of published research concerning physician acceptance of a new drug product, and particularly the identification of factors influencing physician acceptance. The proposed study will attempt to more accurately describe the market environment into which a new, legend drug product is introduced, and to analyze its acceptance within this environment. The market environment chosen

will represent a type wherein previous research efforts have been non-existent, and the community will represent a type of community commonly encountered.

Purposes of the Study

There are two specific purposes of this study. The first purpose is to provide new knowledge relative to the acceptance of a legend drug product within a specific type of market environment. A second purpose is to provide additional knowledge relevant to the acceptance of a new drug product.

The results of this study are intended to provide more accurate information concerning the marketing of a new, legend drug product, and particularly the acceptance of a new, legend drug product in a selected community. The proper use of this information may aid in more effective resource allocation among marketing alternatives available to pharmaceutical firms. The results of this study are also intended to demonstrate a need for further research in the area of new drug product acceptance.

Objectives of the Study

1. To study the effect of a new legend drug product upon the market structure during a specified time period within a selected community.

2. To investigate the relationship between total prescribing frequency and segmented prescribing frequency among selected physicians within the selected community.

3. To determine if any relationship exists between selected physician characteristics of: (a) age; (b) specialty practice; (c) location of medical school alma mater; (d) type of practice; (e) total prescribing frequency; and (f) segmented prescribing frequency among selected physicians and early acceptance of a new, legend drug product within the selected community.

4. To explore the possibility of using pharmacists as a source of latent market information relative to early acceptance of a new, legend drug product.

Limitations of the Study

It must be recognized that the findings of this study may be applicable only to the community studied, since the community may be unique in its effect upon the variables included in this study. In addition, the particular drug product may be atypical in its effect upon the process of new drug product acceptance, and the special class of drug products may collectively be atypical in this respect.

Although the special class of drug products was defined as precisely as possible, there may possibly exist inclusions and exclusions to the drug product category chosen. Finally, the time period

chosen for this study may represent a unique period affecting the use of particular drug products, and may therefore affect the comparability of results.

AREA OF STUDY AND METHODOLOGY

Area Chosen

The community chosen for study will not be specifically identified due to the confidential nature of information collected, and because of a mutual and prior agreement reached with a representative of the new drug product manufacturer. The selection of the community was based on its relatively small population size and its geographic isolation. The community is essentially self-contained, having no close social or economic associations with large, metropolitan areas. Further, it is generally comparable in population size, geography, and economic characteristics with many other communities which comprise a large segment of the total market for a new drug product. For example, the total population of these type communities represented approximately one-half the state's total population.

Census data[2] for the area included a township population of 15,000, an estimated population of 28,000 within five miles of city center, and a retail trading area of 47,000. In order of economic importance, industries included lumber and wood products, agriculture,

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[2] Census data taken from Chamber of Commerce literature in the community studied.

wholesale and retail trade, government agencies, and contract construction. The disposable per-capita income for the area was approximately $2,600, and the disposable per-household income was $8,000. Similar statistics for the state were $2,551 per-capita and $7,881 per-household for the period of the study.

Health facilities for the area included two, 100 bed general hospitals and one government hospital. Thirty-two physicians provided medical care for the general population and ten physicians served the government hospital population. The two groups of physicians were legally restrained from overlapping their respective functions. The ten physicians providing care for the government hospital population were therefore restricted to caring for elderly, male patients, and were not involved in private medical practice. Of the 32 physicians serving the general population, four were not in residence during the complete 12 month period of the study, and were eliminated, thus yielding a total population of 28 physicians for study.

Eleven pharmacies operated through licensure by the Oregon State Board of Pharmacy, with nine pharmacies engaged in retail distribution and two engaged in hospital drug distribution. The two hospital pharmacies confined their distribution functions to patients within the hospital, with the exception of infrequent employee prescription purchases. In addition to the two exclusive forms of drug distribution, the community was geographically isolated. As a

consequence, the prescriptions dispensed by the nine retail pharmacies represented, with very limited exceptions, all drug products prescribed and dispensed for the non-institutionalized population in the area.

The Drug Product

The new drug product chosen for study was a legend drug product. The drug product was typical of a classical chemical moiety, but represented a new chemical entity for which a New Drug Application (NDA) had been approved. The drug product had been granted a patent and a tradename and was promoted to physicians through a saturation campaign (Appendix I). Any differential effect due to selective promotion among physicians was therefore assumed to be negligible. Distinct, if slight, therapeutic advantages over established drug products with the same therapeutic indications were based upon dosage regimen and rate of absorption of the new drug product. Price was not a market factor as the cost-per-dose of the new drug product was virtually identical to other drug products existing for similar indications.

Drug products similar to the new drug product were collectively segmented based on the writer's expertise and a survey of drug literature. Segmentation of drug products was based upon their similarity with the chemical moiety represented by the new drug product, and

similarity of established therapeutic indications of drug products available. The class was constructed to allow studying the market impact of the new drug product among drug products with similar therapeutic indications.

Data Collection

The cooperation and participation of licensed-pharmacist-managers of the nine retail pharmacies was required to obtain the necessary data (Appendix II). Information required was obtained by means of a prescription audit conducted over a period of six weeks during early 1968. Redispensed prescriptions for the category of drug products established were not collected and were assumed to represent a minimal percentage of the total[3].

Data were collected from all retail pharmacies, and for all prescriptions dispensed involving legend drug products in the classification established. Information recorded during the prescription audit included: (a) the date the prescriptions were ordered by the physician; (b) the name of the drug product; (c) the name of the prescribing physician; and (d) the name of the pharmacy dispensing the prescription. The prescription data were recorded for a

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[3] Empirical data confirming this assumption exists, but reference to it would violate the commitment to maintain confidentiality.

continuous 12 month period beginning three months prior to the introduction of the new drug product. The aggregation of this data provided information concerning the volume of prescription use of each drug product in the special class during the 12 month period. It further provided a prescribing history for each physician with respect to the class of drug products established.

A second source of information was obtained by recording all prescriptions dispensed during 12 randomly[4] selected days during the 12 month period. Data recorded in this portion of the audit were: (a) the drug name if in the class studied; (b) the date the prescription was ordered by the physician; (c) the name of the prescribing physician; and (d) the name of the dispensing pharmacy. Aggregation of this data yielded a sample record for each physician with respect to his total volume of prescribing.

Information concerning physician personal characteristics was obtained from a computer library which supplied information concerning each physician's age, specialty, medical school alma mater, and type of practice (Appendix III).

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[4] A random sampling of days was completed by assignment of consecutive numbers, beginning with number one, to each day in the 12 month period. All numbers correlating with Saturdays, Sundays, or legal holidays were then excluded from consideration. The first 12, three-digit random numbers taken from a table of random digits that correlated with the remaining days were then designated as the random sample of days.

A mail questionnaire (Appendix IV) of licensed-pharmacist-managers representing the nine pharmacies within the selected community was utilized to collect data relative to exploring the possibility of using this group as a latent source of market information. An initial mailing and follow-up mailing two weeks later resulted in eight[5] completed, usable questionnaires being returned. The participating pharmacists were requested to evaluate physicians within their community on the basis of several criteria. The questionnaire consisted of eight questions and was designed primarily to elicit pharmacist responses relative to knowledge of physician prescribing patterns. Other areas of information included in the questionnaire, such as a question dealing with the quality of medical care provided by physicians, were based on inferred relationships. Each question required pharmacists to evaluate and list not more than five physicians in decreasing order of conformity to the question asked. For each question, physicians were ranked by weighting the number of listings they received and the order of their listing (Appendix IX).

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[5] One questionnaire was discarded as unusable due to the fact the pharmacy had not been a business entity during the entire 12 month period of the study, and because the relevant physician population for the pharmacy consisted of four physicians.

MARKET STRUCTURE

Established Drug Class

The data collection procedures resulted in an audit of 97, 817 prescriptions during the 12 month period. Data were collected from 7, 339 prescriptions written for drug products contained within the special class of drug products, and from 1, 156 prescriptions collected by the random sampling procedure.

Chart I shows an aggregate, per-month representation of data recorded for the special class of drug products. A seasonal variation in prescribing was indicated, and was anticipated due to the established therapeutic indications of drug products comprising the category.

A national, bi-weekly prescription survey is also represented in Chart I (4). This survey covered the identical time period and, although the classification was slightly more inclusive, appeared to have provided comparable results. In summary, the gross data collected for the specific drug products appeared to be basically representative of the general class of drug products. The conclusion was based upon: (a) prior expectations inferred from therapeutic indications; and (b) a national survey of similar design.

Drug Firm

A majority of the prescriptions recorded for the special class of drug products were marketed by four pharmaceutical firms. Monthly prescriptions recorded per firm for the special class of drug products are shown in Chart II. Of the 7, 339 prescriptions collected for drug products of the special class, 6, 130, or 83. 5 percent, of these were for drug products produced by the four firms. The season variation indicated in Chart I appears to have been a factor influencing each of the four firm's market environment.

The seasonal fluctuations of total demand tended to obscure the shifting nature of demand among the firms represented. The shifting effect was more clearly represented in Chart III, wherein percentages of the total market represented by each firm, or market shares, were calculated. Annual market shares per firm ranged from 13. 2 percent to 30. 2 percent, while monthly market shares ranged from 6. 7 percent to 39. 7 percent. The wide range in firm market shares served to clearly indicate the shifting of demand among firms.

New Drug Manufacturer

Chart IV shows the total market share of the special class of drug products for the firm manufacturing the new drug product. The

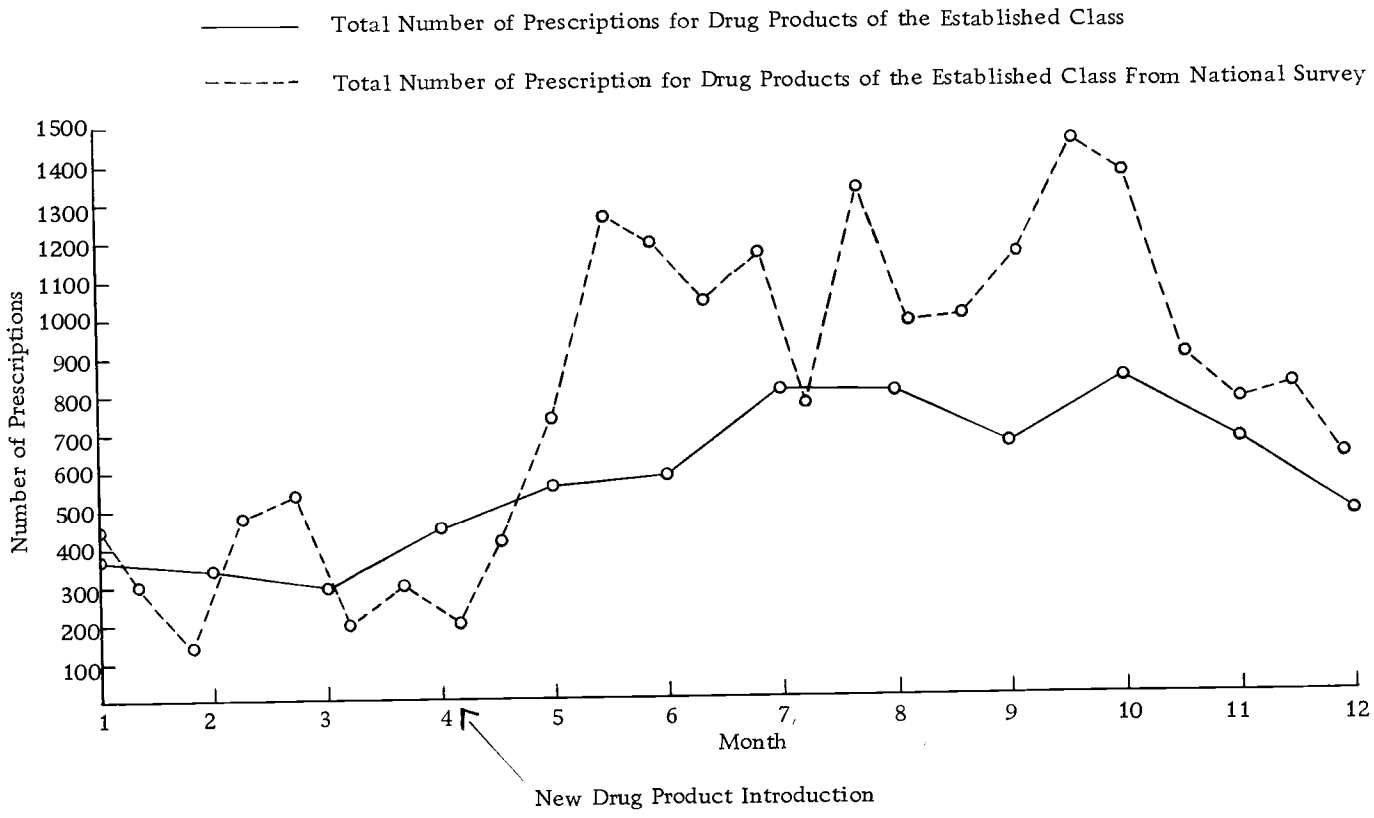

Chart I

Occurrance of Prescriptions in the Established Class of Drug Products

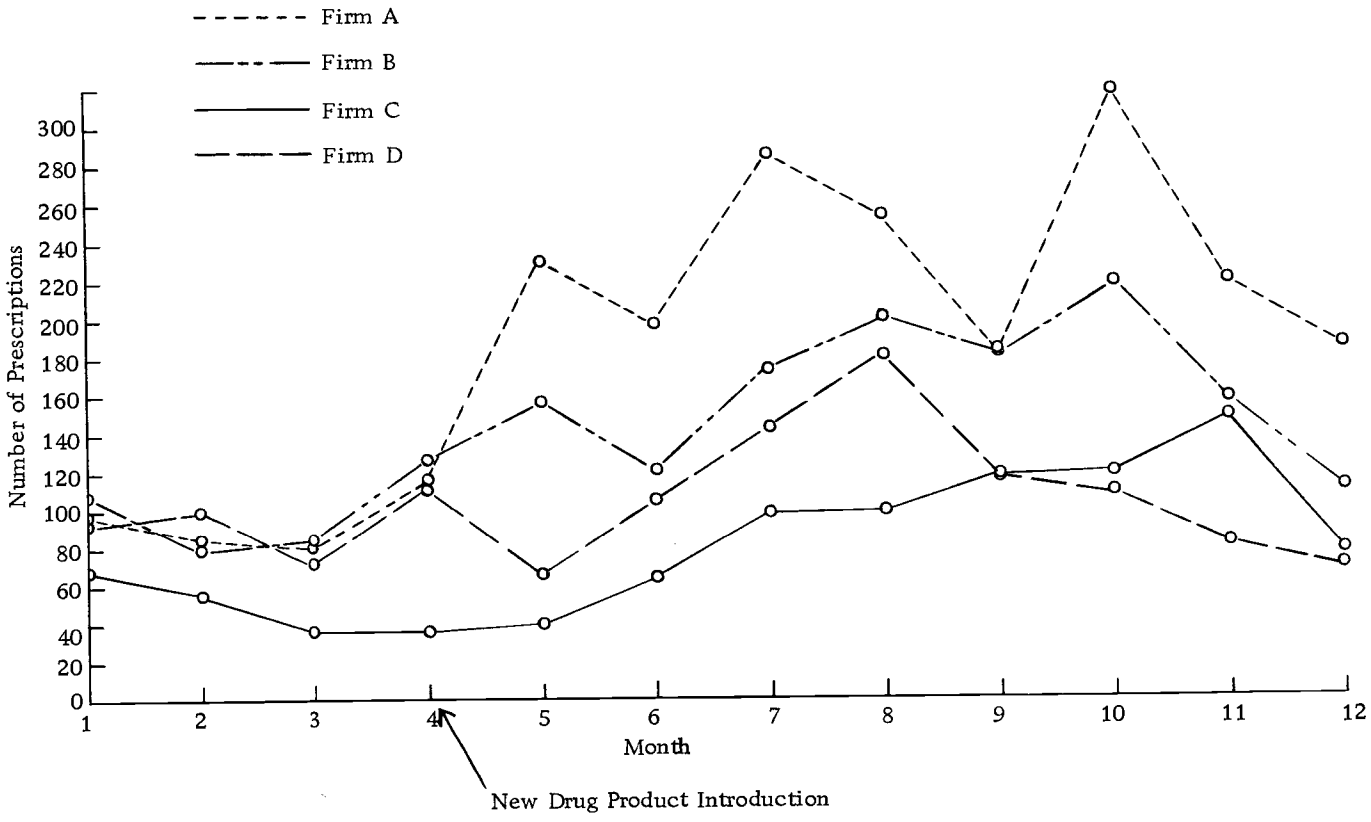

Chart II

Total Number of Prescriptions Dispensed for Four Selected Firms' Drug Products in the Established Class

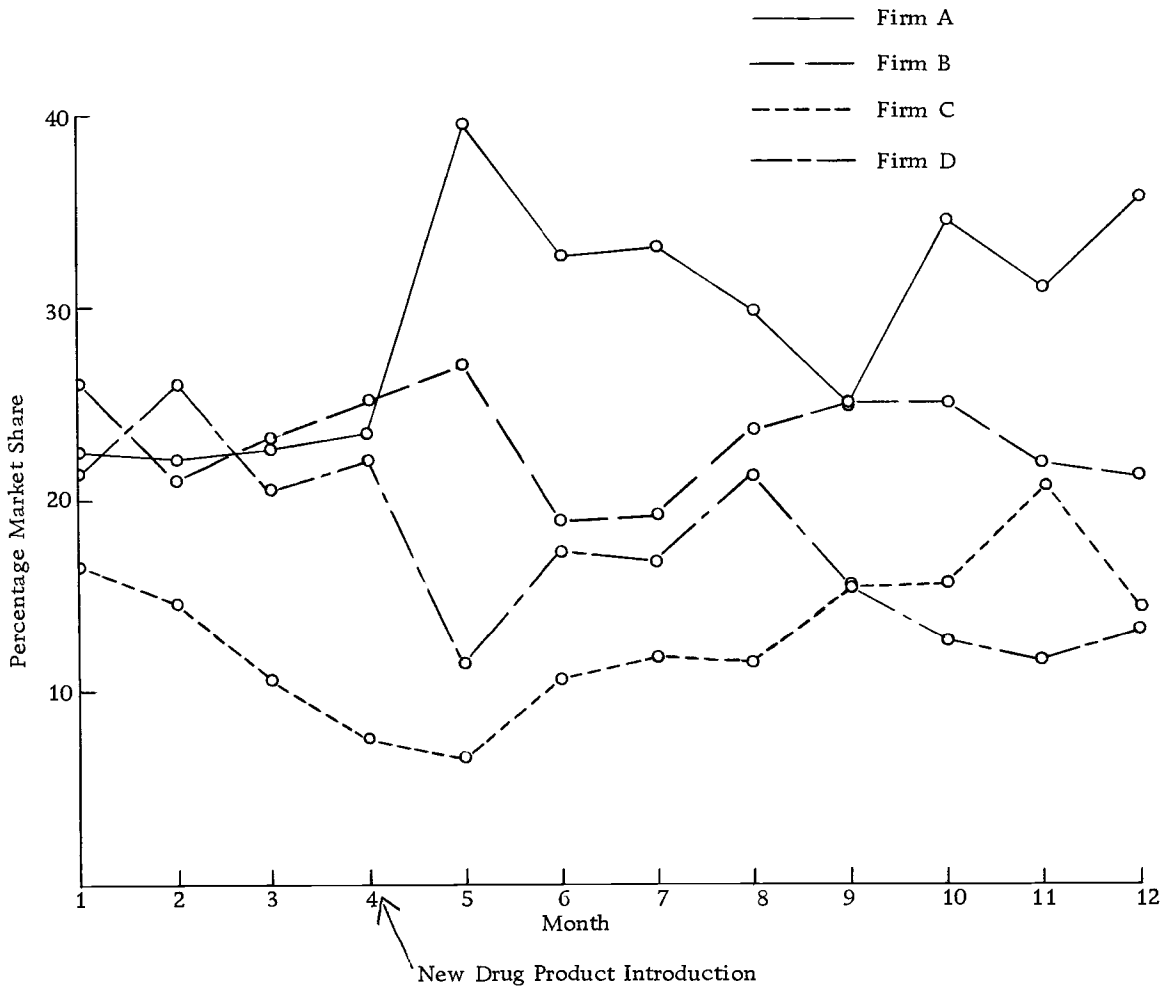

Chart III

Percentage Market Shares for Four Selected Firms' Drug Products in the Established Class

specific drug products within the special class which comprise the total market share of the firm are also represented in Chart IV. The introduction of the new drug product resulted in two of the firm's drug products declining in market share. Market share for product A_2 declined by 5.5 percent, and market share for product A_3 declined by 3.5 percent. The firm's total market share for the special class of drugs, however, increased by 13.5 percent. The net gain in firm market share was largely attributable to A_1, the new drug product. The total gain in market share appeared to have been partially attributable to a shifting demand among the other components of the firm's product mix.

Selected Drug Products

The prescriptions written and recorded for six drug products within the special class represented a mean market share of 72.4 percent. These six products were marketed by three of the four firms previously shown to command the major share of the market. These six drug products (See Table I) had monthly market shares ranging from 65.5 percent to 78.2 percent. The stability of the collective market share for these six products was indicated by a computed standard deviation of 4.4 percent. For the portion of the market represented by the six drug products, a per product monthly mean of 12.2 percent was calculated with a range from 5.5 percent to 35.5

Table I. Percentage Share of Market for Selected Drug Products of the Established Class of Drug Products

Drug Product	Month 1	2	3	4	5	6	7	8	9	10	11	12
B_1	12.3	12.1	14.8	16.0	15.5	14.2	13.3	18.4	25.0	21.4	21.2	17.0
B_3	17.4	10.6	12.2	12.3	12.6	7.2	7.9	9.2	5.5	6.0	5.9	7.8
D_2	25.2	22.6	28.7	30.8	14.2	22.2	21.7	26.0	20.3	14.8	15.5	17.3
A_2	23.7	24.8	28.3	19.0	12.5	16.4	12.3	9.2	9.0	11.1	13.2	17.0
C_1	21.4	19.9	16.0	11.5	8.8	14.8	16.5	14.0	17.8	18.2	19.1	13.8
A_1				9.4	25.4	25.2	28.3	24.2	22.4	28.5	25.1	27.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percent of Class Market	76.9	73.8	65.5	66.5	76.7	72.6	72.0	78.2	70.2	78.0	66.6	71.4

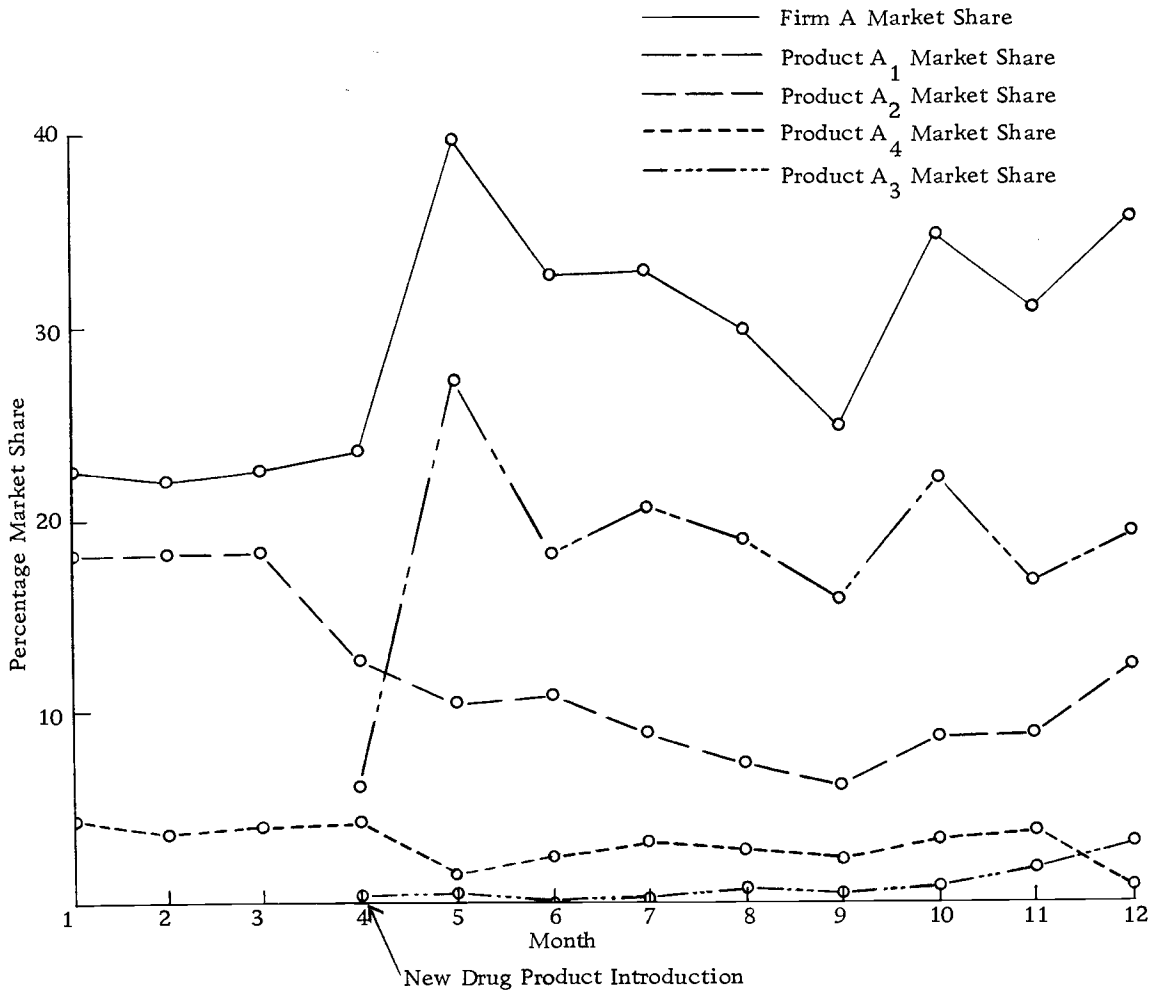

Chart IV

Aggregate and Component Percentage Market Share for Firm A for Established Class of Drug Products

percent. These results further suggested that the major changes occurring in this market structure were shifts in demand among particular drug products.

Absolute change in the demand for drug products of the special class occurred during the 12 month period of this study (See Table II). Each firm's drug products were recorded and an index based on the first month of the study was calculated. The highest monthly value recorded was an index value of 371.0 for the firm introducing the new drug product. The index values for firm A were consistently higher than values for any other drug firm after the new drug product was introduced. Firm A achieved an index value of 197.8 by the end of the study; this was the highest 12th month value of any firm in the study.

Although Firm A was the only firm to introduce a new drug product during the specified time period, Firm C reduced the price of one of its drug products significantly. This action could be interpreted as creating a quasi-new product to be added to the product mix. The price decrease by Firm C was followed by a significant increase[6] in prescriptions for that drug product. The relative market share for Firm C declined by only 2.0 percent at the end of the 12 month period

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[6] Prior to the price decrease, the drug product never occurred in the prescription audit. Four months after the price decrease, the drug product held 7.9 percent of the market in the special drug class.

Table II. Index* of Absolute Change from the Prescribing of Four Selected Firms' Drug Products of the Established Class of Drug Products

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Firm B	100.0	74.8	76.6	117.8	145.8	111.2	160.9	186.0	170.1	200.0	144.9	103.7
Firm A	100.0	90.3	84.9	125.8	247.3	211.8	304.4	371.0	193.5	320.4	235.5	197.8
Firm D	100.0	107.6	78.3	118.6	71.8	114.1	155.4	196.7	122.8	117.4	88.0	75.0
Firm C	100.0	82.4	54.5	55.9	57.4	95.6	150.0	142.6	164.7	200.0	216.2	110.3
Total of Firms A, B, C, and D	100.0	86.6	75.0	108.5	136.4	135.0	194.4	202.5	163.3	210.0	167.2	121.9
Total for the Established Class	100.0	92.7	85.2	120.9	140.8	146.4	208.0	204.9	176.9	208.3	171.6	125.7

Introduction of New drug product (A_1)

* Index based on first month of prescription audit.

(See Chart III). This was the smallest decline in market share among the three firms with declining shares. Firm C achieved an index value of 110.3 by the end of the study, which was the second highest 12th month value recorded. The remaining two firms with stable product mixes experienced the smallest 12th month values. Firm B returned to approximate equality with a value of 103.7, and Firm D experienced a decline in value to 75.0.

Summary

The data presented has emphasized the shifting nature of demand within the established class of drug products, both for firms and specific drug products. The relative and absolute changes further emphasized the importance of a new drug product to pharmaceutical firms. The drug product mix remained essentially constant, with the exception of a new product introduction and a product price decline. The firm introducing the new product was the only firm effecting a market share increase, and the firm effecting the price decline had the smallest decline of all remaining firms. These two firms also had the largest absolute increase in utilization of their drug products in the last month of the study.

PHYSICIAN PRESCRIBING FREQUENCY

All Drug Products

A specific objective of the study was to investigate the relationship between total prescribing frequency and segmented prescribing frequency among the selected physicians. To do so, the prescriptions recorded were allocated among the 28 physicians. Ten, or 35.0 percent, of the physicians accounted for 53.2 percent of the prescriptions audited.

Established Class of Drug Products

A similar allocation procedure was completed for drug products of the special class. Five physicians, or 17.5 percent, accounted for 51.2 percent of the prescriptions in the special class of drug products.

A rank ordering of physicians utilizing individual total prescribing means was graduated in descending order. A similar rank ordering of physicians using their respective special class prescribing means was also constructed. A non-parametric statistical technique, Kendall's tau (See Appendix V), was employed to determine if any relationship existed among the orderings of the calculated means. The value obtained from the test was +.62, indicating a positive correlation significant at the 95.0 percent confidence level. This result indicated that the two classifications of prescribing frequency

are positively correlated. However, the degree of correlation would suggest that physician prescribing frequency defined as total prescribing frequency and as prescribing frequency for drug products of the special class, may not be used interchangeably.

PHYSICIAN ACCEPTANCE AND PERSONAL CHARACTERISTICS

The critical role new drug products assume in a pharmaceutical firm's perspective has been discussed, and some evidence of that role has been presented. These observations would strongly suggest that processes whereby a physician accepts and uses a new drug product are of primary importance to pharmaceutical firms. In order to better understand these processes the data were approached in two ways to attempt to define: (a) physician acceptance; and (b) physician early acceptance.

Physician acceptance of the new drug product was operationalized by the presence of that drug product in a physician's monthly prescribing record. Recognition of initial use as sufficient evidence of acceptance avoided quantitative bias in terminology. To have required more than one prescription order in defining acceptance might also have invoked a therapeutic judgement on the efficacy of the drug product. Thus, once a physician had become an acceptor of the new drug product he remained definitionally so, even though he might discontinue its use.

The actual number of physicians prescribing the new drug product during the time period, and the cumulative number of physicians prescribing the new drug product are represented in Chart V. Fifteen physicians, or 53.2 percent of all physicians, were classified as acceptors

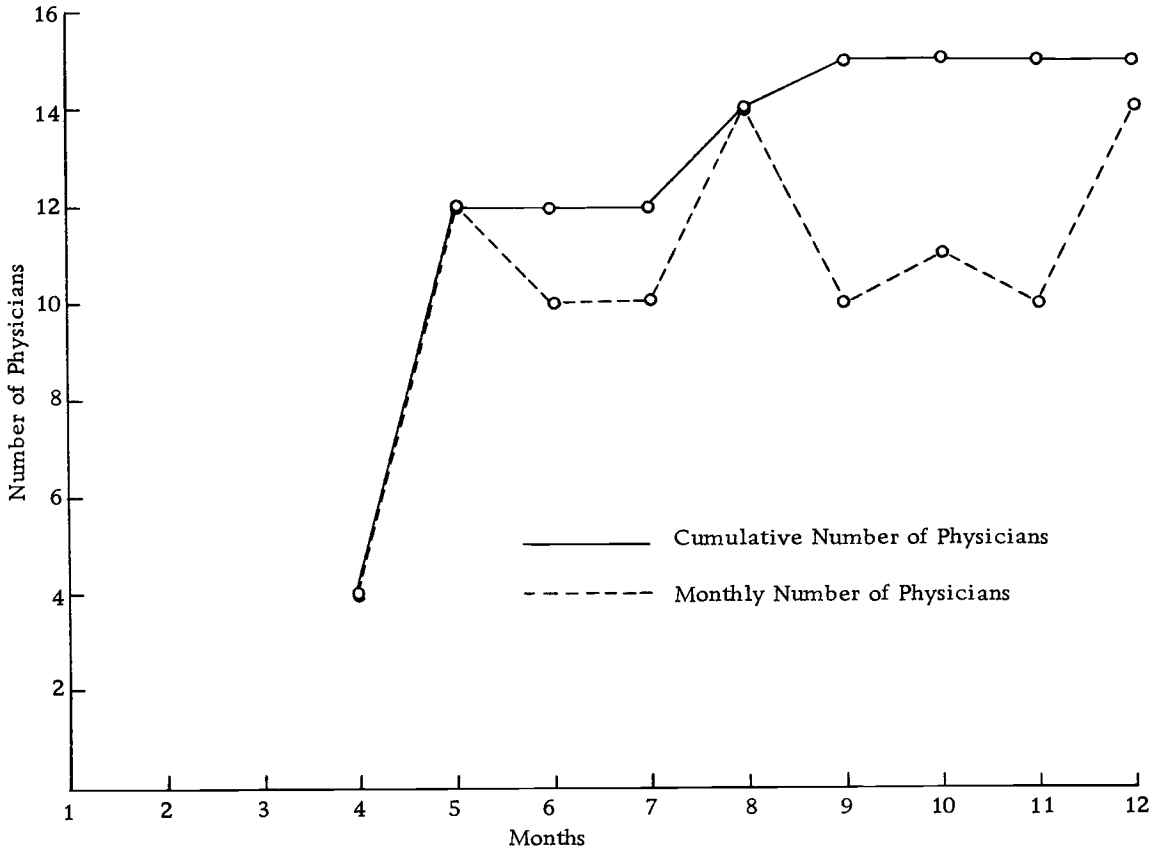
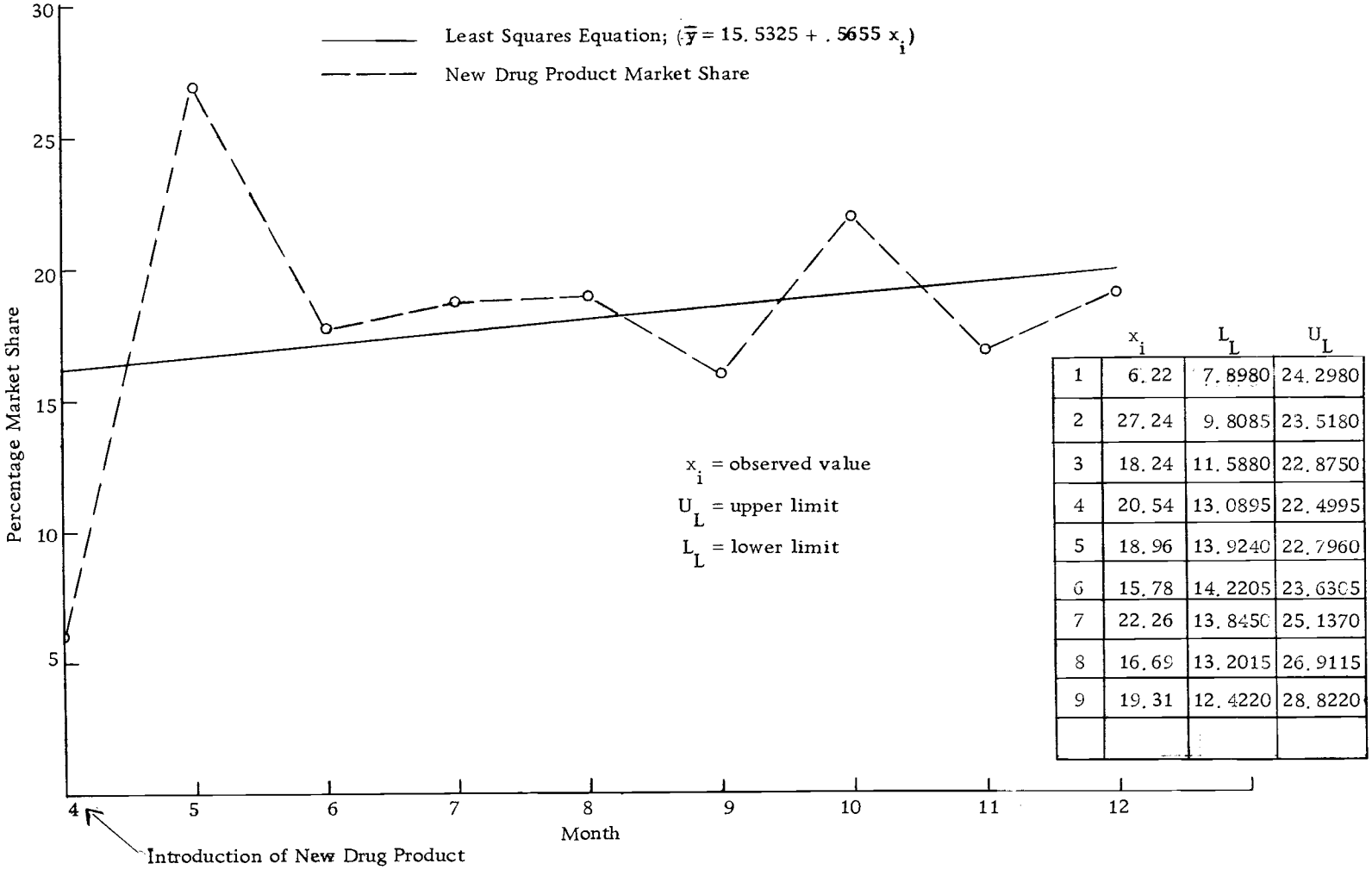


Chart V

Number of Physicians Prescribing the New Drug Product



	x_i	L_L	U_L
1	6.22	7.8980	24.2980
2	27.24	9.8085	23.5180
3	18.24	11.5880	22.8750
4	20.54	13.0895	22.4995
5	18.96	13.9240	22.7960
6	15.78	14.2205	23.6305
7	22.26	13.8450	25.1370
8	16.69	13.2015	26.9115
9	19.31	12.4220	28.8220

Chart VI

New Drug Product Percentage Market Share and Fitted Least Square Line

of the new drug product on the basis of their prescribing records during the 12 month period. Four physicians prescribed the new drug product the first month it was available. The highest number of physicians (14) to prescribe the new drug product did so in the fifth and ninth months after introduction.

A literature search was initiated to assist efforts in defining "early acceptance" of an innovation. Current thought in diffusion research is varied regarding reason for early acceptance, but is uniformly in agreement that the early portion of an innovation's life cycle is a unique period. A classification of acceptance periods has been suggested based on a normal curve distribution and as an ordinal distribution (16). Neither, however, was specifically precepted on marketing criteria and were thus unsatisfactory for the purposes of this research.

A means for defining "early acceptance" was derived from data recorded for the new drug product using monthly market share as the determinant factor. Monthly market shares achieved by the new drug product are shown in Chart VI, together with a least squares (See Appendix VI) linear regression calculated from the data. The values tested for all time periods, except the first two, validated the least squares line. It was therefore concluded that the first two time periods were unique in their relationship with acceptance of the new drug product.

The significance of the data represented by Chart VI was two-fold. First, the initial period in the new drug product's life cycle was quantitatively different from the subsequent period; and second, the new drug product rapidly achieved a stable market position. Consequently, "early acceptors" were defined as those physicians accepting the new drug product in the first two months of the 12 month period, and all other physicians were defined as "not early acceptors." Dichotomizing the physicians in this manner resulted in a classification of 12 early accepting physicians and 16 physicians who were not early acceptors.

An interesting aspect of the data may be observed by comparing Chart V with Chart VI. Although the market for the drug product appeared to be stabilized by the third month of its availability, the actual number of physicians responsible for its market share declined. This pattern of acceptance was similar to that encountered by the Columbia group (2, p. 31). A tentative explanation offered has been that physicians first to use the new drug product do so sparingly. Information concerning its effects must be accumulated before it is widely accepted. Some physicians may discontinue the new drug product's use on the basis of the accumulated information. Once this knowledge has accumulated, however, other physicians benefit from it and may prescribe the new drug product more frequently.

Physician acceptance of a new drug has been posited as primarily

a function of the risk involved, with increasing risks directly associated with rate of acceptance. The rapidly changing pace of American medical care, from the country doctor of the early-twentieth century to the institutionalized physician of the contemporary era, compound the problem of risk. Although the medical profession formally advocates the development of new skills, techniques, and use of new drug products, their rapid implementation may serve to increase the burden of keeping abreast of expanding medical knowledge. The difficulty in keeping informed is further compounded by the increased patient loads faced by current physicians (22, p. 2). In summary, the physician of the current era is faced with the dilemma of allocating his available time among these two alternatives.

One mechanism the physician utilizes to cope with the dilemma facing him is the development of a standard of drug therapy and particular preferences for certain drug products. The standard, obtained from observing patient's responses over the years, is used to compare the progress of any new case. As a physician becomes familiar with certain modes of drug therapy over time, he has to a certain extent dealt with uncertainty and minimized risk. The physician has satisfied himself that a specific drug product assures a certain level of therapeutic success, and has become aware of its idiosyncracies and learned to control them. He has learned to identify and deal with undesirable effects of the drug product and

understands the risk involved with certain drug products.

A new mode of therapy, or a new drug product, thus presents the physician with a new risk involvement. He must choose between either accepting the new drug product, or rejecting the new drug product. In accepting the new drug product he must not only be assured that it constitutes an improvement in therapy, he must learn what idiosyncracies are relevant for the new drug product. The specific risk contributed by the new drug product is increased by the uncertainties resulting from discarding previous standards of evaluation. The physician must now learn to evaluate what is, and what is not, a satisfactory patient response. The physician faces a new dilemma, whether to accept the new drug product or not.

Personal characteristics of physicians have been shown to indicate the presence of risk reduction mechanisms. For example, certain personal characteristics of physicians have been correlated with the rate of acceptance of a new drug product. Personal characteristics of physicians may have less differentiating connotation in a small community, and their correlation with early acceptance of a new drug product may be different. Therefore, it is appropriate that physician characteristics previously shown to correlate with rate of acceptance of a new drug product in larger metropolitan areas should be studied in a small, relatively self-contained community.

Age

In developing standards for choice of drug therapy, a physician's risk involvement is decreased. Adverse drug reactions, therapeutic responses, and patient idiosyncracies are less likely to be catastrophic. It seems reasonable to believe the physician's standard of therapy should become more ingrained over time. If this is so, the probability of a physician accepting a new drug product should be a decreasing function with advancing age. The view has been a recurrent theme in the literature, with one source suggesting physician age as an external characteristic which can be easily measured and of marketing value (8).

To attempt to determine if any relationship existed between early acceptance of the new drug product and ages of physicians, a physician age classification was constructed on the basis of a suggested applicability from prior studies. Physicians were dichotomized into groups of: (1) those greater than 50 years of age; and (2) those less-than or equal-to 50 years of age. Twelve physicians, or 42.9 percent, were more than 50 years of age. Six of these physicians were early acceptors and six were not early acceptors.

Sixteen physicians were 50 years of age or less. Six of these physicians were early acceptors and 10 were not early acceptors. The data indicated a contradictory direction to what had been

anticipated, as a higher percentage of the older physicians were early acceptors than younger physicians. A chi-square statistical technique (See Appendix VII) was employed and the resultant value was not significant at the 90.0 percent confidence level. Thus, the results indicated that no relationship existed between a classification of physicians aged more than 50 years and those less-than or equal-to 50 years of age, with early acceptance of the new drug product.

Organization of Practice

The organization of physicians' services may be generally classified as either solo-practice, which is comprised of independently practicing physicians, or group practice, which is composed of more than one physician per practice. Solo-practice has been the dominant organizational form of United States' medicine. However, since World War II the group practice form of medical organization has shown pronounced growth and has been legitimized as an alternative method of practice.

The organizational characteristics of these two types of practice suggest that there could be differential rates of new drug product acceptance among physicians. The results of previous research have suggested that physicians slower to learn of new drug products will be slower to accept them (2). Therefore, a physician in solo-practice and relatively isolated from his colleagues may be slower

to accept a new drug product. In addition, such a physician has the potential of both lacking and avoiding written or verbal communication channels. This failure in communication decreases his potential for learning about a new drug product, thereby increasing his risk in accepting it. A comparative analysis of group-practice vs. solo-practice as it affects rate of new drug product acceptance was therefore undertaken.

Within the select community, 14 physicians were engaged in group-practice and 14 were engaged in solo-practice. Seven of the physicians engaged in group-practice were early acceptors of the new drug product and seven were not early acceptors. The 14 physicians engaged in private practice were composed of five early acceptors, or 35.7 percent, and nine physicians, or 64.3 percent, who were not early acceptors. The chi-square value calculated was not significant at the 90.0 percent confidence level. The inference drawn from the results was that no relationship existed between physicians who were early acceptors of the new drug product and the organization of their practice in terms of solo- or private-practice.

Professional Certification

Professional certification qualifies a physician to practice a medical specialty and indicates an expertise in a particular area of medicine. Professional certification is received only after a

customary two years post-graduate medical training and satisfactory completion of a written and oral examination. Therefore, a physician-specialist may be more knowledgeable about innovations affecting his specialty than would a physician in general practice. The specialist-physician's particular expertise as a referent or advisor also may enhance his channels of communication to other practitioners. In addition, his social status among his colleagues may be a factor. It is also possible that a physician-specialist receives more patients with resistant forms of disease which have not responded to classical forms of drug therapy, and thus is more willing to try a new drug product. Finally, given a specialist-physician's expertise, the risks involved in his acceptance of a new drug product may be decreased.

On the other hand, the smaller community may also present a problem to the physician in terms of his formal specialization and actual practice. A small community may be unable to support diverse specialties, requiring a specialist to expand his activities into areas of general practice and even other specialties[7]. By the same token, a physician in general practice may be required to expand his function into peripheral areas of specialties. If these conditions hold, then differences in rates of acceptance of new drug products should

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[7] One specialist, a surgeon, ranked fourth highest in prescribing the special class of drug products and fifth highest in total prescribing.

decrease between specialists and non-specialists.

Among the 28 physicians within the community, 14 were specialists and 14 were general practioners. Eight of the general practioners, or 57.1 percent, were early acceptors and six, or 42.9 percent, were not early acceptors. Four specialist-physicians, or 28.6 percent, were early acceptors and ten, or 71.4 percent, were not. The chi-square value computed was not significant at the 90.0 percent confidence level. The results suggested that no relationship existed between physicians who were early acceptors of the new drug product and whether the physicians were specialists or non-specialists.

Medical School Alma Mater Location

The medical school from which a physician graduates has also been suggested to influence his rate of acceptance of a new drug product. A partial explanation may be that the ties of an in-state graduate to his alma mater are closer than the ties of an out-of-state graduate to his alma mater. This implies greater time and procedural difficulties in communication, as well as a greater probability to substitute alternatives for those communications the medical school would normally provide. The extent to which a medical school is an institution distributing current information implies the argument may be valid. Also, a medical school by virtue of its mechanisms for professional communications, may advise the acceptance or rejection of

a drug product through distributing not only information but influence. It may therefore be argued that the geographic distance a physician locates from his alma mater may be inversely related to his propensity to accept an innovation. In recognition of these arguments, the effect of medical school location upon the early acceptance of the new drug product was investigated.

The physicians were dichotomized into those eight, or 28.6 percent, who graduated from the single medical school in Oregon and 20, or 71.4 percent, who graduated from medical schools outside Oregon. Six in-state graduates, or 75.0 percent, were early acceptors of the new drug and two, or 25.0 percent, were not early acceptors. The 20 out-of-state graduates were composed of six, or 30.0 percent, who were early accepting physicians and 14, or 70.0 percent, who were not early accepting physicians. The chi-square value computed was significant at the 95.0 percent confidence level. A Pearson's contingency correlation (See Appendix VIII) was employed with a resultant value of .52. The results may be regarded as indicating a positive correlation between early acceptance of the new drug product and in-state medical school graduation. There is one intervening factor that should also be considered which may have contributed to these results. This factor pertains to the particular nature of the in-state medical school in this study. The possibility exists that this particular medical school is atypical in its recommendations and

influence. The results nevertheless indicate a significant degree of relationship among the conditions and definitions of this analysis.

Total Prescribing Frequency

The frequency with which a physician prescribes a drug product has been suggested to have marketing applicability (8). Various indices have been constructed to identify high prescribing physicians in much the same manner as indices are used to identify physicians inclined to be early acceptors of a new drug product. The potential relationship between prescribing frequency and early acceptance could be rationalized in terms of opportunity. Physicians who are more frequent prescribers of drug products may encounter earlier and more frequent opportunities to use a new drug product than physicians who are less frequent prescribers. It could also be expected that a more frequent prescriber of drugs has personally allayed the inherent risks he perceives in prescribing drug products.

Data obtained from the prescription audit were utilized to calculate a mean prescribing frequency per day for each physician. Physicians were dichotomized into a high prescribing group and a low prescribing group. The 14 high prescribing physicians included ten, or 71.4 percent, physicians previously classified as early acceptors and four, or 28.6 percent, who were not early acceptors. The 14 low prescribing physicians included one, or 7.1 percent, early accepting

physician and 13, or 92.9 percent, physicians who were not early acceptors of the new drug product. The chi-square value computed was significant at the 99.0 percent confidence level. A Pearson's contingency correlation value of .69 was also calculated. The results indicated a high degree of positive correlation between high prescribing frequency and early acceptance of a new drug product among the community of physicians.

Class Prescribing Frequency

The final physician variable studied was the frequency of prescribing per physician for drug products within the special class. The same argument advanced for total prescribing frequency is applicable for prescribing frequency within a particular class of drug products. What was previously discussed in terms of opportunity, risk, and propensity to prescribe new drug products could also be applicable for class of drug products. More importantly, the specific nature of the data would indicate a possibly higher correlation with early acceptance. The Columbia study concluded ". . . the extent of the doctor's use of this family of drugs proved to be a more powerful predictor of the timing of his first use of (name of drug) than any other factor considered in the entire study" (2, p. 37).

A mean, monthly prescribing frequency for drug products prescribed within the special class was calculated for each physician.

The 28 physicians were again dichotomized into high and low prescribing groups of physicians. Eleven, or 78.6 percent, of the high prescribing physicians in the special class of drug products were early acceptors and three, or 21.5 percent, or the high prescribing physicians in the class of drug products were not early acceptors. The 14 physicians who were low prescribers of the special class of drug products were composed of one, or 7.2 percent, early acceptor and 11, or 92.8 percent, not early acceptors. The chi-square value computed was significant at the 99.0 percent confidence level, and the Pearson's contingency coefficient value for the data was .82. The results of this analysis would indicate that high prescribing frequency for the class of drug products is positively correlated with the early acceptance of a drug product within that class. Further, the correlation involving high frequency prescribing for the special class of drug products had the highest degree of association of any physician variable tested.

THE MAIL QUESTIONNAIRE

The preceding analysis has indicated that certain physician characteristics such as medical school alma mater location, general prescribing frequency, and special class prescribing frequency were correlated with early acceptance of a new drug product. The analysis has also indicated the relative strengths of association for the variables under the conditions studied. The results have indicated the strongest degrees of associations existed between acceptance of a new drug product and prescribing patterns of physicians.

The use of prescribing information to increase marketing efficiency, however, is impaired by the general unavailability of such information. One mechanism which does provide such information is a prescription audit. However, this mechanism is recognized as being extremely costly and, when employed, the procedure is usually conducted in general terms. Prescription audit information has been traditionally accumulated for the purposes of identifying drug firm and drug product market shares. Data required for these purposes does not require information concerning individual physician's prescribing records. However, it has been demonstrated that individual physician's prescribing records provided a high positive correlation with early acceptance of a new drug product. Thus, prescription audit procedures have normally omitted valuable marketing information.

The reluctance of retail pharmacies to participate in prescription audit procedures is another consideration in conducting such a procedure. A reason for this reluctance may be that prescription prices and pharmacy business practices are readily illustrated by a prescription audit. The indiscriminate use of these two types of information could easily damage an individual pharmacy's competitive retail position. As a consequence, specific information concerning physician prescribing patterns by this means has been generally unavailable.

An alternate, convenient, less costly method of obtaining information relative to physician prescribing patterns would be of obvious value for marketing purposes. It is possible that an alternative to the prescription audit could be the individual pharmacist. Therefore, the nine licensed-pharmacist-managers of retail pharmacies in the selected community were chosen for evaluation as a source of relevant market information.

This choice was based on three assumptions. The first assumption was that the pharmacist is in possession of market information. This appears to be a reasonable assumption based on the distribution system for drug products. This system is based upon physician prescribing and pharmacist dispensing of medications and is enforced by legal and professional codes. Further, the pharmacist is responsible for meticulous evaluation of each prescription for its safety and

validity. Through this process, a pharmacist develops background and insight concerning his professional environment and the existing pharmaceutical market. The second assumption was that information held by pharmacists is relevant to marketing of drug products. Previous analyses of prescribing data would suggest that if pharmacists possess knowledge of physician prescribing patterns, the information is relevant. The third assumption was that information possessed by pharmacists is available through practical and inexpensive means. A literature search provided no published descriptions of efforts to employ the pharmacist as a source of marketing information.

These three assumptions were tested by the use of information obtained from the mail questionnaire (See Appendix IV).

High Prescribing for All Drug Products

Information requested in the first question concerned pharmacist's perceptions of the total volume of prescribing among individual physicians. Fourteen physicians were chosen by pharmacists as high prescribers in terms of total frequency of prescribing. The 14 physicians chosen as high prescribers were classified as high prescribing physicians and the remaining 14 physicians were classified as not high prescribing physicians. Eleven of the high prescribing physicians chosen by pharmacists, or 78.6 percent, were early acceptors of the new drug product and three, or 21.4 percent, were not early acceptors.

The 14 not high prescribing physicians included one, or 7.2 percent, early acceptor and 13, or 92.8 percent, not early acceptors.

The chi-square value computed was found to be significant at the 99.0 percent confidence level. A Pearson's contingency correlation was calculated and the value was .82, indicating a positive correlation. The results indicated a positive correlation between physicians designated by pharmacists as high prescribing physicians, and physicians defined as early acceptors of the new drug product. The strength of the correlation was equal to that of the most highly correlated variable from the prescription audit. That variable was the frequency for the established class of drug products.

A subsequent procedure involved calculating a rank-order correlation between pharmacist's rankings and prescription audit rankings relative to total prescribing frequency. The Kendall's tau test was utilized and a value computed of +.60; this value was significant at the 95.0 percent confidence level. It may be inferred from the results of the rank-order correlation that actual physician prescribing and pharmacist's perceptions of physician prescribing were positively correlated.

Physicians Most Likely to Prescribe New Drug Products

The second question requested pharmacists to designate physicians most likely to prescribe new drug products. Eight physicians

were selected by pharmacists as most likely to prescribe new drug products. Six, or 75.0 percent, of these physicians were early acceptors and two, or 25.0 percent, were not early acceptors. Six physicians, or 30.0 percent, of the remaining 20 physicians were early acceptors and 14, or 70.0 percent, were not early acceptors. The computed chi-square value was significant at the 99.0 percent confidence level. A Pearson's contingency correlation was also calculated and a value of .52 resulted. It may be inferred from the results of the analysis that a positive correlation existed between the classification of physicians selected by pharmacists as most likely to prescribe a new drug product, and the classification of physicians defined in this study as early acceptors. The strength of the correlation for this question, however, was less than for the first question dealing with total frequency of prescribing. Therefore, it must be recognized that the results of question two relating to pharmacist's perceptions of physicians most likely to prescribe new drug products may be significant only in a statistical sense.

Physician Advisors

Question number three requested pharmacists to designate physicians most frequently called upon by their colleagues for advice. Aspects of risk minimization and expertise are involved in advisor relationships, and have been suggested to be correlated with rate of

acceptance of a new drug product (2, p. 123).

Eleven physicians were designated by pharmacists as most frequently called upon by their colleagues for advice. Seventeen physicians were residually classified as not perceived by pharmacists as frequent advisors to their colleagues. Of the 11 frequent advisors designated, six, or 55.5 percent, were early acceptors, and five, or 44.5 percent, were not early acceptors. The 17 physicians not classified as frequent advisors included six, or 25.3 percent, early acceptors and 11, or 64.7 percent, not early acceptors.

The computed chi-square value was found not to be significant at the 90.0 percent confidence level. The results indicated that no relationship existed between physicians designated by pharmacists as frequent advisors to their colleagues, and physicians defined as early acceptors of the new drug product.

Physician Popularity

The fourth question requested pharmacists to rank physicians in relation to the physician's popularity within the community. This evaluation was included because physician social interaction has been viewed as being a significant indicator of rapid rate of new drug product acceptance (2, p. 79).

Questionnaire responses listed ten physicians as being most popular within the community. The ten physicians selected by

pharmacists included six, or 60.0 percent, early acceptors and four, or 40.0 percent, not early acceptors. Six of the remaining 18 physicians, or 33.3 percent, were early acceptors and 12, or 66.7 percent, were not early acceptors. A chi-square value was calculated and found not to be significant at the 90.0 percent confidence level. The results indicated that no relationship existed between physician popularity as defined by pharmacists and early acceptance of a new drug product as defined.

Special Class Prescribing Frequency

The fifth question requested pharmacists to categorize physicians by frequency of prescribing for drug products within the established class of drug products. Pharmacists designated 12 physicians as most frequent prescribers of the drug products in the established class. The 12 physicians included nine, or 75.0 percent, early accepting physicians and three physicians, or 25.0 percent, who were not early acceptors. The remaining group of 16 physicians contained three, or 18.8 percent, who were early acceptors and 13, or 71.2 percent, who were not early acceptors. A chi-square value was computed and found to be significant at the 99.0 percent confidence level. A Pearson's contingency correlation value computed for the data was .68.

The results of the analysis indicated a positive correlation

existed between physicians who were early acceptors of the new drug product in this study, and the physicians selected by pharmacists as being most frequent prescribers for drug products of the established class. A weaker relationship was noted between the actual variable (C=.82) and the perceived variable (C=.68). One reason for this may have been pharmacists' interpretations of the questionnaire's intended definition of the special class of drug products.

The possibility that interpretation varied was tested by computing a rank-order correlation. Pharmacist's rankings of physician prescribing frequencies for the established class of drug products, and actual rankings of physician prescribing frequencies for the special class of drug products were calculated. Kendall's tau test produced a value of +.45 which was significant at the 90.0 percent confidence level. The agreement between actual rankings and pharmacist's rankings for all drug products (τ = +.60) was greater than the agreement between actual ranking and pharmacist ranking for drug products of the established class (τ = +.45). This difference may have contributed to the respectively weaker correlations which resulted with early acceptance of the new drug product.

Quality of Medical Care

Pharmacists are economically, educationally, and functionally oriented toward the drug product component of medical care. It

would be reasonable to infer from this that pharmacists view a new drug product as an advance within their professional domain. If a new drug product is viewed as such, then its use may be perceived as an indication of high quality medical care. It was posited that pharmacists might develop strong beliefs concerning the quality of medical care offered by physicians.

It may also be posited that early physician acceptance of a new drug product is associated with a high quality of medical care. Further, it may be reasonable to assert that pharmacists may accurately perceive the quality of medical care provided, just as they have indicated an accurate perception of prescribing patterns.

The sixth question requested pharmacists to designate physicians providing high quality medical care to the community studied. Fourteen physicians were classified by pharmacists as providing high quality medical care. Eleven of the physicians selected, or 78.6 percent, were not early acceptors. The remaining group of 14 physicians not selected by pharmacists included one, or 7.2 percent, early acceptor, and 13 physicians, or 92.8 percent, who were not early acceptors. A chi-square value was computed and determined to be significant at the 99.0 percent confidence level. The results indicated a positive correlation existed between the group of physicians defined by pharmacists as providing high quality medical care and the group of physicians defined as early acceptors of the new

drug product. A Pearson's contingency correlation was computed and the resultant value was .82, a value equal to the strongest previously determined correlation.

Prescribing Frequency for Special Class

The questionnaire was constructed with the prior expectation that the seventh question would be the most meaningful. This question defined the special class of drug products and requested pharmacists to designate those physicians most likely to prescribe a new drug product in that class. Nine physicians were selected by pharmacists as most likely to prescribe a new drug in the established class of drug products. Eight physicians, or 88.9 percent, were early acceptors and one, or 11.1 percent, was not an early acceptor. The 19 remaining physicians included fourteen, or 78.9 percent, physicians who were not early acceptors. The computed chi-square value was found to be significant at the 90.0 percent confidence level, and a Pearson's contingency coefficient of .71 was calculated. The results indicated a positive correlation existed between early acceptance, as defined, and the pharmacist's classification of physicians likely to prescribe a new drug product of the established class.

Physicians Requesting Advice

Physicians who actively expand their professional relationships have been described as those most likely to accept a new drug product (2). Because pharmacists may serve as sources of drug therapy information to physicians, inclusion of pharmacists into a physician's confidence could be an indication of early acceptance of a new drug product.

The eighth question, which requested pharmacists to select those physicians who most frequently requested information from pharmacists, was designed to test the assumption. Seventeen physicians were classified by pharmacists as most frequently requesting information, leaving a residual group of 11 physicians. Ten of the physicians chosen, or 58.8 percent, were early acceptors of the new drug product and seven physicians, or 41.2 percent, were not early acceptors. The residual group of 11 contained two, or 18.2 percent, early accepting physicians, and nine physicians, or 71.8 percent, who were not early acceptors. A computed chi-square value was significant at the 99.0 percent level of confidence, and a Pearson's contingency correlation of .52 was calculated. The results indicated a positive correlation existed between physicians designated as early acceptors, and physicians designated by pharmacists as requesting drug information most frequently.

SUMMARY AND CONCLUSIONS

A need for new and more accurate information concerning one aspect of pharmaceutical marketing, the acceptance of a new drug product, was shown to exist. One basis for this need was the limitation inherent in previous research on the subject. These limitations were both definitional, as in the classification of prescribing frequency, and functional, as in the population size of the community studied. A further justification for this need involved the normative procedures of contemporary pharmaceutical marketing. These procedures involve massive expenditures by pharmaceutical firms for promotion, research, and development in order to achieve optimum market impact. Based upon this need, the study was designed to provide new and supplemental information about new drug product acceptance which could assist the achievement of optimum market impact.

The study included a descriptive analysis of a selected pharmaceutical market over time. The market behavior both prior and subsequent to introducing the new drug product was particularly relevant to this study.

The critical role of the physician necessitated attempting to identify the characteristics of the physician which influenced new drug product acceptance. Physicians' personal characteristics were

analyzed in two parts. Initially, physician prescribing patterns were studied to determine the relationship between total prescribing frequency and prescribing frequency in the special class of drug products. Secondly, the potential relationships between selected physician characteristics and early acceptance of the new drug product were investigated.

There were two specific purposes for developing this study. The first purpose was to provide new knowledge relative to the acceptance of a new drug product within a specific type of market environment. A second purpose was to provide additional knowledge relevant to the acceptance of a new drug product.

The study was initiated by selecting an appropriate community in which the research was conducted. Criteria utilized in selection of the community included: (a) small population size; (b) geographic isolation; and (c) demographic comparability with a large segment of the state's population. Data concerning a new drug product which had been introduced into the community's medical care system were then incorporated into the research design.

The data concerning the acceptance of a new drug product were collected utilizing a prescription audit of nine retail pharmacies within the community. A total of 97, 817 prescriptions were audited, with data recorded from 8, 495. The prescription audit further provided information concerning utilization of the remaining

drug products within the established class of drug products.

The descriptive analysis of the selected pharmaceutical market indicated a seasonal variation in utilization of drug products within the special class. The seasonal variation was shown to be a market factor for each of four selected firms, and for each of six selected drug products.

The seasonal aspect of demand variation may be extremely important to the efficient marketing of drug products. The new drug product was introduced at the beginning of an increase in prescribing for the class of drug products. The new drug product achieved a substantial portion of the market both rapidly and continuously. A possible reason for this rapid acceptance might be the additional awareness on the part of the physician during the initial increase in demand. The apparent receptiveness of physicians to a communication at this time period seemed to indicate that the seasonal variation in therapeutic indications may be a factor which affects the marketing success of a new drug product.

The data further indicated a high degree of substitutability existed between drug products within the special class. This was apparent both in terms of specific products and in terms of product mixes for specific firms. A high degree of substitutability between products poses a dilemma to the firm competing in such a market. On the one hand, because of the degree of substitutability, the need

for optimum impact of marketing effort is intensified. Paradoxically, the high degree of substitutability indicates product homogeneity and imposes a severe impediment to achievement of optimum marketing impact. Because the drug product remains constant, the marketing effort becomes the critical variable to be used in achieving optimum marketing impact. A firm facing such a dilemma is likely to turn to the task of obtaining and utilizing accurate market information. Therefore, a major factor to achieving optimum impact of marketing resources in the pharmaceutical industry may be the acquisition and employment of accurate information.

The firm introducing the new drug product was the only firm experiencing an increase in market share at the end of the 12 month period. The firm experiencing the smallest decrease in market share effected a significant price decrease for one of its products, in effect creating a new product. Both drug products contributed substantively to their respective firm's market shares, and to their respective firm's absolute drug product market. The behavior the market exhibited subsequent to the introduction of the new drug product(s) indicated the critical importance a new drug product plays in pharmaceutical marketing.

A corollary to the critical role of new drug products is the role of physicians in accepting a new drug product. Information from previous studies indicated rate of new drug acceptance was correlated

with prescribing frequency. Therefore, an investigation of general prescribing frequency and class prescribing frequency was conducted. A rank-order analysis indicated physician prescribing frequency for all drug products to be positively correlated with prescribing frequency for the special class of drug products. The degree of correlation between the two classifications ($\tau = +.60$), although positive, indicated that the two classifications are not identical. Attempts to use general prescribing frequency as a predictor of early acceptance of a new drug product must therefore be aware of the dissimilarity which exists between classifications.

The results indicated that utilization of information relative to frequency of prescribing for a class of drug products may allow achievement of optimum market impact. The restraints experienced in obtaining this type of information, such as costs of collection and the cooperation required, may preclude this as a practical source of market information. Therefore, general prescribing frequency information may be utilized because it provides sufficient, but less than optimum, market impact. Given general prescribing frequency information as a proximate index of more valuable information, other indices may exist which may be easier to obtain and of greater value. For example, patient load analysis, patient acceptance criteria, and patient scheduling might provide proximate indices of value to drug product marketing.

An operational definition of physician acceptance of a new drug product was developed. Acceptance was based on initial presence of the new drug product in the physician's monthly prescribing record. The method used for defining acceptance avoided quantitative bias in terminology, and avoided therapeutic judgments concerning efficacy of the new drug product.

The pattern of acceptance of the new drug product indicated a number of physicians who discontinued prescribing the new drug product after the initial acceptance period. The remaining group of physicians, however, prescribed the new drug product more frequently than they previously had. Therefore, a firm marketing a new drug product is motivated to persuade as many physicians as possible, as rapidly as possible, to prescribe the new drug product. In this manner, the absolute effect of the later attrition of physicians is minimized.

Early acceptance of the new drug product was defined by means of a least-squares equation using time as the independent variable and new drug product market share as the dependent variable. The first two months after the new drug product's introduction were determined as being the early acceptance period and physicians accepting the new drug product during this period were defined as early acceptors. Early acceptance, defined in such a manner, represented an objective evaluation of what is normally evaluated in subjective terms. The

definition thus established was consistent with marketing criteria, in terms of a product life cycle, and sociological criteria in terms of the unique aspect of time in accepting an innovation. As a result of the methodological consistency of the definition, the criteria utilized may be consistently replicated. This means of defining early acceptance may provide a consistent and measurable standard for evaluating marketing impact of new drug products.

The new drug product life cycle encountered in this study was consistent with prevailing conceptualization of a typical new drug product life cycle. If this particular pattern of life cycle is typical of drug products, the method used in defining early acceptance may be applicable to new drug product marketing procedures. Further research in this area seems indicated to determine: (a) under what conditions a linear function may be used to define early acceptance; and (b) the time period in which linearity holds.

The communications disseminated concerning the new drug product were defined by representatives of the drug firm as a saturation campaign. Detailing of physicians, direct mailings, medical journal inserts, drug product samples, and hospital displays were coordinated during a period of five months. The effectiveness of this campaign was evidenced by the market shares achieved by the new drug product. The new drug product achieved the highest market share within the special class of drug products two months after its

introduction. Also, the new drug product achieved the highest market share of all drug products within the special class for seven of the nine months following its introduction. In this instance, it appeared the campaign undertaken negated the difficulties posed by substitutability among products and physician risk involvement.

The definition of early acceptance established was used to group physicians into early acceptors and not early acceptors. The established importance of early acceptance indicated the need to determine what factors influenced physicians to be the first to use a new drug product. Physician early acceptance of a new drug product was shown to be positively correlated with certain physician personal characteristics. Results of these correlations are shown in Table III.

Table III. Correlation Values for Physician Characteristics

Physician Characteristics	Correlation Value (C)
Age	---
Organization of Practice	---
General vs. Specialty Practice	---
Medical School Alma Mater Location	.52
Total Prescribing Frequency	.69
Class Prescribing Frequency	.82

The strongest correlation with early acceptance was for frequency of prescribing in the special class of drug products. This correlation was followed, in diminishing order of strength, by: (a) prescribing frequency for all drug products; and (b) medical school

alma mater location.

The correlations obtained for medical school alma mater and frequency of class prescribing replicated the results of previous studies. The results of these studies have indicated a strong influence of the medical school alma mater upon prescribing patterns of physicians. The replication of the results suggest a more detailed effort to investigate and identify the influence of medical school alma mater upon physicians' prescribing patterns would be useful.

The replication of the correlation between rate of acceptance of a new drug product and prescribing frequency indicated this relationship may be universally recurrent. One explanation may be the potential for this attribute to reduce physicians' risk involvement. Another explanation may be the potential for this attribute to increase physicians' opportunity to be presented with indications for its use. Both explanations offer direction for future research efforts attempting to better explain physician prescribing patterns.

Certain physician personal characteristics not shown to be correlated with rate of acceptance of a new drug product in this study correlated within a large population of physicians. As a possible explanation, it seems reasonable that heterogeneity of association would flourish and differentiation of characteristics would be enhanced in a large population of physicians. However, in a small population of 28 physicians it seems more likely that homogeneity

would rule. Certainly each physician in a population of 28 would have some awareness of all other physicians, due to social, professional, or intellectual interactions. This potential to associate would be expected to decrease as the population increased, and may thus have affected the results for the physician variables of: (a) age; (b) organization of practice; and (c) group vs. specialty practice. Nevertheless, this explanation suggests the employment of sociometric techniques would be appropriate in similar research efforts within the type of community studied.

The correlation values obtained for physician characteristics and early acceptance may be a function of the socialization process posited. Conversely, these values may simply be a function of the limitations inherent in a statistical design utilizing a small sample size. Further analyses of small populations appear to be indicated if this issue is to be clarified.

If the attainment of optimum marketing effort and impact is premised on the availability of relevant marketing information, a less costly, convenient alternative to the prescription audit would appear to be of value. Pharmacists within the community were selected for evaluation as a possible alternative. This selection was made because of the existing distribution system for drug products, and because of the pharmacist's role in that distribution system.

The market information requested related primarily to

pharmacists' perceptions and knowledge of physician prescribing patterns. Several physician classifications constructed from pharmacists' responses were shown to be correlated with early acceptance of the new drug product. Results of these correlations are shown in Table IV.

Table IV. Correlation Values for Questionnaire Results

Questionnaire Classification	Correlation Value (C)
Most Frequent Advisor	---
Most Popular Within Community	---
Most Likely to Request Information	.52
Most Likely to Prescribe New Drug	.52
Class Prescribing Frequency Highest	.68
Most Likely to Prescribe New Class of Drug	.71
Provide Highest Quality Medical Care	.82
General Prescribing Frequency Highest	.82

The results indicated that pharmacists were just as valuable a source of market information as the prescription audit when seeking information concerning total prescribing frequency of early accepting physicians. The results further indicated that pharmacists were slightly less valuable sources of information concerning class prescribing frequency.

The results also indicated that pharmacists may be a reliable source of marketing information concerning identification of early acceptors of a new drug product, and a new drug product within a special class of drug products. This interpretation resulted from comparison of correlations obtained from the prescription audit and the pharmacist questionnaire.

Although no substantiating information was provided by the analysis, the results indicated pharmacists perceived early acceptors to provide a high quality of medical care. The value calculated showed a high degree of positive correlation with early acceptance of the new drug product. However, it was not possible to establish whether this perception indicated a professional or an economic orientation.

The results also indicated that pharmacists' experience with physicians through physician requests for drug information may be a potential means for identifying early accepting physicians. If early accepting physicians do in fact request information frequently, then the pharmacist may be a source of reliable identification of early accepting physicians.

The failure to obtain positive relationships for the advising question and popularity question may be explained in two ways. The first being that these variables may not be related to physician early acceptance of a new drug product. The second explanation could be that the variables may be related to early acceptance but the pharmacist was not a source of such information.

These analyses have indicated that the pharmacist can be used as a valid and reliable source of information concerning particular aspects of physician prescribing patterns. However, it must be recognized that the size of the community and the diffusion of

physicians' prescriptions into the distribution system could have affected the results. The results would suggest that the use of the pharmacist as a convenient and less costly source of marketing information has potential usefulness.

The study has affirmed the importance of new drug product marketing within the pharmaceutical industry, if only within one class of drug products. This class of drug products, however, is an extremely important class of drug products to the industry.

The study has contributed new information relative to determining the life cycles of drug products, and acceptance of a new drug product within a commonly encountered community type.

The study has replicated some of the results of previous studies of drug product acceptance, tending to confirm or reject previous inferences established concerning the relationships of physician characteristics with new drug product acceptance.

The study has identified a potentially useful new source of information concerning prescribing patterns of physicians.

Finally, the study has indicated a number of areas to which new research efforts should be directed.

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APPENDICES

APPENDIX I

Detailing Frequency for Selected Physicians for New Drug Product in Selected Area

	7 1/2 Months					
	Promotional Time Period 6	Promotional Time Period 7	Promotional Time Period 1	Promotional Time Period 2	Promotional Time Period 3	Promotional Time Period 4
1. Dr. A	D		D		D	D
2. " B	D	D		D	D	D
3. " C	D	D	D		D	D
4. " D						
5. " E	D	D	D	D	D	D
6. " F	D	D	D	D	D	D
7. " G		D			D	
8. " H	D					
9. " I	D	D				
10. " J						
11. " K	D	D			D	
12. " L		D			D	
13. " M	D	D	D	D	D	D
14. " N	D	D			D	
15. " O	D	D			D	
16. " P		D	D	D		
17. " Q	D	D	D	D	D	D
18. " R					D	
19. " S	D	D			D	
20. " T						
21. " U	D	D		D	D	
22. " V						
23. " W	D	D		D	D	
24. " X	D	D	D	D	D	
25. " Y	D	D		D		
26. " Z	D	D	D	D	D	D
27. " 2A	D				D	
28. " 2B	D	D	D	D	D	D

Introduction of new drug product (A_1)

APPENDIX II. Monthly Prescriptions Recorded during Prescription Audit for each Drug Product in Established Class of Drug Product

Product	Month 1	2	3	4	5	6	7	8	9	10	11	12	
B	39	34	34	53	69	62	82	115	128	143	100	63	
B_2	7	14	16	25	29	19	36	18	18	25	19	14	
B_3	55	30	28	44	56	32	49	61	28	40	28	29	
B_4	6	2	4	4	2	6	5	5	8	6	8	5	
D_1	12	7	6	8	3	8	9	10	9	9	8	5	
D_2	80	92	66	102	63	97	134	171	104	99	73	64	
E_1	42	34	57	42	22	27	53	46	71	30	40	39	
F_1	3	12	9	34	26	53	71	28	32	48	32	21	
A_2	75	70	65	63	60	72	76	61	46	74	62	63	
A_3	18	14	14	21	9	14	28	24	16	27	27	5	
A_1				31	158	110	176	160	115	191	118	100	
C_1	68	56	37	38	39	65	102	92	91	122	90	51	
G_1	7	17	15	31	41	37	33	41	39	24	33	19	
A_4				2	3	1	3	7	3	6	12	16	
C_2								5	21	14	57	24	
	412	382	351	498	580	603	857	844	729	858	707	518	= 7,339
Percent of Total	5.61	5.21	4.78	6.79	7.90	8.21	11.68	11.50	9.93	11.69	9.64	7.06	= 100.0%

Introduction of New drug product (A_1)

APPENDIX III

PHYSICIAN PROFILE

Name _____

Year of Birth _____

Sex _____

Licensed _____

Specialty _____

American Board Certification _____

Year Licensed _____

Government Hospital _____

Oregon Medical Association Membership _____

Federal Employee _____

State Employee _____

Medical School of Graduation _____ Year _____

UOMS Faculty (type) _____ (status) _____

House Staff (Intern) _____ (Resident) _____ (Fellow) _____

Yellow Page Listing _____ Specialty _____

PHARMACIST QUESTIONNAIRE

IF YOU CANNOT ANSWER A QUESTION COMPLETELY, PLEASE LIST AS MANY PHYSICIANS AS YOU CAN. IF YOU CANNOT LIST ANY PHYSICIANS, GO TO THE NEXT QUESTION.

1. Please list the (name of community) physicians whom you feel are the most frequent prescribers.
    1. Dr. _____(highest prescriber)
    2. Dr. _____(2nd highest prescriber)
    3. Dr. _____(3rd highest prescriber)
    4. Dr. _____(4th highest prescriber)
    5. Dr. _____(5th highest prescriber)
2. Please list the (name of community) physicians whom you feel are most likely to prescribe NEW drug products.
    1. Dr. _____(Most likely new drug prescriber)
    2. Dr. _____(2nd most likely new drug prescriber)
    3. Dr. _____(3rd most likely new drug prescriber)
    4. Dr. _____(4th most likely new drug prescriber)
    5. Dr. _____(5th most likely new drug prescriber)
3. Please list the physicians whom you feel are most frequently called upon for professional advice by other physicians.
    1. Dr. _____(Most frequently called upon)
    2. Dr. _____(2nd most frequently called upon)
    3. Dr. _____(3rd most frequently called upon)
    4. Dr. _____(4th most frequently called upon)
    5. Dr. _____(5th most frequently called upon)
4. Please list the physicians whom you feel are most popular within the (name of community) social community.
    1. Dr. _____(Most popular)
    2. Dr. _____(2nd most popular)
    3. Dr. _____(3rd most popular)
    4. Dr. _____(4th most popular)
    5. Dr. _____(5th most popular)

5. Please list those physicians who most frequently prescribe (description of established class of drugs).

    1. Dr. _____(Most frequent prescriber)
    2. Dr. _____(2nd most frequent prescriber)
    3. Dr. _____(3rd most frequent prescriber)
    4. Dr. _____(4th most frequent prescriber)
    5. Dr. _____(5th most frequent prescriber)

6. Please list those physicians whose prescribing habits (type of drugs used, prescribing patterns, etc.) you feel indicate they provide the highest quality medical care.

    1. Dr. _____(Highest quality medical care)
    2. Dr. _____(2nd highest quality medical care)
    3. Dr. _____(3rd highest quality medical care)
    4. Dr. _____(4th highest quality medical care)
    5. Dr. _____(5th highest quality medical care)

7. Please list those physicians whom you feel would be most likely to prescribe a new (description of established class of drugs) product.

    1. Dr. _____(Most likely)
    2. Dr. _____(2nd most likely)
    3. Dr. _____(3rd most likely)
    4. Dr. _____(4th most likely)
    5. Dr. _____(5th most likely)

8. Please list the physicians who most frequently request drug information of any type (dose, strength, dosage form, etc.) from you.

    1. Dr. _____(most frequently requests information)
    2. Dr. _____(2nd most frequently requests information)
    3. Dr. _____(3rd most frequently requests information)
    4. Dr. _____(4th most frequently requests information)
    5. Dr. _____(5th most frequently requests information)

THANK YOU

APPENDIX V

KENDALL'S TAU TECHNIQUE

Kendall's tau (τ) test is a measure which can be used to correlate two ordinal scales. As long as two variables can be ranked, several tests exist for evaluating their relationship and, although Kendall's tau is more difficult to calculate than others, it appears to be of most value in general and particularly when ties occur within the rankings. A value of +1.0 indicates perfect agreement in the rankings and a value of -1.0 indicates perfect disagreement, a value of zero indicates no relationship.

Kendall's tau is computed by observing all pairs of cases and noting whether or not the ranks are in the same order. Assigning a value of -1.0 to all pairings not in the correct order and a value of +1.0 to all pairings in the correct order yields a sum S. The tau value is computed by the formula:

$$1. \qquad \tau = \frac{S}{1/2\ N\ (N-1)}$$

When ties occur, the value of tau can be generalized as follows:

$$2. \qquad \tau = \frac{S}{\sqrt{1/2\ N(N-1)-T}\ \ \sqrt{1/2N(N-1)-U}}$$

where $T = 1/2\ \Sigma\ t_i(t_i-1)$, t_i being the number of ties in each set of ties in variable A, and

$U = 1/2\ \Sigma u_i(u_i-1)$, u_i being the number of ties in each set of ties in variable A.

For sample sizes of 10 or more the sampling distribution of S will be approximately normal with a mean of zero and a variance given by:

$$3. \qquad \sigma_s^2 = 1/18\ N(N-1)\ (2N+5)$$

This value of σ_s^2 determines σ_s which can be used in the denominator of Z to test the null hypothesis that A and B are related. Thus:

$$4. \qquad Z = \frac{S-O}{\sigma_s}$$

may be used to determine significance of the tau value.

APPENDIX VI

LEAST SQUARES EQUATION TECHNIQUE

A denoted value of y obtained from a linear, single regression equation may be labelled $\hat{y}$, and the prediction equation will be:

$$1.\quad \hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$$

where β_0 and β_1 represent estimates of the true parameters β_0 and β_1. The least squares principle minimizes the sum of squares deviations of the observed values (x_i) from the predicted values (y_i). Expressed mathematically, SSE represents the sum of squares of deviations, commonly callued the sum of squares for error, or:

$$2.\quad SSE = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

Substituting for y_i in SSE obtains:

$$3.\quad SSE = \sum_{i=1}^{n} [y_i - (\hat{\beta}_0 + \hat{\beta}_1 x_i)]^2$$

which yields β_1 and β_0 as the solutions to the following pair of simultaneous equations:

$$4.\quad \hat{\beta}_1 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2} = \frac{n \sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{n \sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)}$$

$$5.\quad \hat{\beta}_0 = \hat{y} - \hat{\beta}_1 x$$

known as the least square equations.

Calculating limits on prediction error is accomplished by computing the value:

$$6.\quad SSE = \sum_{i=1}^{n} (y_i - \bar{y})^2 - \frac{\hat{\beta}_1}{n} n[\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)]$$

and substituting into

$$7.\quad S^2 = \frac{SSE}{n-2}$$

yields a value of S^2, the variance of the random error ϵ, with 2 degrees of freedom.

The expected value of y may be calculated from:

$$8.\quad \hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$$

The corresponding $(1-\alpha)$ confidence interval for the expected value of y becomes:

$$9.\quad \hat{y} \pm t_{\alpha/2}\, S \sqrt{\frac{1}{n} + \frac{(x_p - \bar{x})^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}}$$

for any given value of x. Observations with values beyond the confidence interval limits are then regarded as beyond the explainable error of the least squares line at a particular level of confidence $(1-\alpha)$.

APPENDIX VII

CHI-SQUARE CONTINGENCY TECHNIQUE

The chi-square test (χ^2) may be used whenever an evaluation is intended to determine whether empirically determined frequencies differ from theoretically determined frequencies. The test has many applications, the most common of which in social sciences are "contingency problems" in which nominal scales have been cross-classified. In this study, two-by-two contingency classifications were used as illustrated in the following manner:

	Early accepting physicians	Not early accepting physicians	
Variable A	X_{11}	X_{12}	$N_{1.}$
Variable B	X_{21}	X_{22}	$N_{2.}$
	$N_{.1}$	$N_{.2}$	$N_{..}$

where X_{ij} refers to the observed values (number of physicians), and N_{ij} refers to row and column totals.

To test the significance of differences between empirical observations and theoretical observations, a null hypothesis (H_o) and an alternate hypothesis (H_a) are constructed. In this case:

H_o : Variable A = B

H_a : Variable A $\neq$ B

Expected frequencies are calculated for each cell by the following manner:

$$E_{11} = \frac{(N_{1.})\ (N_{.1})}{N_{..}} \qquad E_{12} = \frac{(N_{1.})\ (N_{.2})}{N_{..}}$$

$$E_{21} = \frac{(N_{2.})\ (N_{.1})}{N_{..}} \qquad E_{22} = \frac{(N_{2.})\ (N_{.2})}{N_{..}}$$

and a chi-square value with one degree of freedom ($\chi^2_{(1)}$) calculated by:

$$\chi^2_{(1)} = \sum_{\substack{\text{all} \\ ij}} \left[\frac{(X_{ij} - E_{ij})^2}{E_{ij}} \right]$$

If the calculated chi-square value is greater than the chi-square value listed in a table at 95 percent level of confidence, the inference to be made is that a chi-square value that large could only occur randomly 5 percent of the time. The null hypothesis (H_o: Variable A = Variable B) is therefore rejected and the alternate hypothesis (H_a: Variable A $\neq$ B) is accepted. The chi-square test may be also used as a "two-tailed" test to establish an alternate hypothesis of H_a: Variable A $>$ Variable B, as was done in this study.

APPENDIX VIII

PEARSON'S CONTINGENCY CORRELATION

The chi-square (χ^2) technique provides descriptive measures which can summarize several relationships and compare them to determine the strongest relationship. By convention, statisticians have adopted the custom of using a value of zero to indicate independence using chi-square measures and a value of 1.0 to indicate the relationship is complete.

The measure of association used in this study is Pearson's contingency coefficient C which is defined as:

$$C = \sqrt{\frac{\chi^2}{\chi^2 + N}}$$

When the variables are independent, C becomes zero. The upper limit of C, however, depends on the number of rows and columns in the chi-square contingency classification. In the two-by-two case used in this study, the upper limit of C^2 becomes $N/(N+N)$ since χ^2 can reach a maximum of N. Therefore the upper limit of C is .707. For this reason, C has been corrected in all cases of use in this study by dividing by .707, thus bringing the upper limit of C to unity and adhering to convention.

APPENDIX IX

QUESTIONNAIRE EVALUATION PROCEDURE

Pharmacists' responses concerning physician characteristics were evaluated separately for each question. The evaluation for each question was based on two criteria: (a) the number of times each physician was listed; and (b) the particular order in which each listing occurred.

The number of times each physician's name could occur per-question was eight; or once for each usable, completed questionnaire. This value was accepted as the best indicator of the pharmacist's perception in ranking physicians for the particular question. Therefore, a physician who was selected six times in one question would be rated higher than a physician selected five or fewer times. Physicians were then placed in a rank order listing by use of this initial criterion.

An additional procedure was necessary, however, due to the large number of ties which resulted. The second criterion used was the level at which a physician was listed for each question. A pharmacist, in completing each question, was required to list physicians from one through five in order of conformity to the question asked (Appendix IV). A value of five was assigned a listing indicating highest conformity to the question, a value of four was assigned a listing indicating second highest conformity, and so on until a value of one was assigned a physician listing fifth in order of conformity. Physician listing values were then summed for each question and physicians were ranked accordingly. These values were then used to break any ties which had resulted in using the first criterion, with a higher ranking taking precedence over a lower ranking.