Statistical cost analysis of long-terrm care facilities in Montana with policy implications
by Bernard Nicholas Ries

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Applied Economics
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Abstract:
The objective of this research is to determine the effects selected facility characteristics have on cost per patient day for long-term care in Montana. The main hypotheses test the relationships between cost and ownership, location, size, quality and occupancy rate. The final results are used to project added expenses incurred from subsidizing small relatively costly long-term care facilities.

Ordinary least squares regression analysis is the main statistical tool used in this study. The selected characteristics are defined as the explanatory (independent) variables and relevant cost categories are used as the dependent variables. The estimated regression coefficients indicate the change in the average cost per patient day given a change in explanatory variables.

The final estimated average cost model is used to estimate average cost per patient day given location, ownership, size, occupancy rate and quality level. A least cost facility is also determined and the average cost per patient day is estimated. This estimated cost is compared with the current actual cost of long-term care in Montana and savings to the State are determined for funding only least cost facilities.

The final conclusions indicate location has no significant effect on average cost. Economies of scale are indicated as inverse relationships between cost and size. A similar5 relationship exists between cost and occupancy rate and suggests economies of full utilization. The least cost facility size is 122 beds. The estimated potential cost saving to the State for funding only least cost facilities ranges from one to four million dollars. These savings may be totally offset by added costs of developing least cost facilities.

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A thesis submitted in partial fulfillment
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of

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ABSTRACT

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Chapter 1

INTRODUCTION TO THE STUDY

Objectives

This research studies the nursing home industry in Montana. Certain objectives are used as guidelines to limit the scope of the research. They are:

1) Review of a general economic model which relates costs to operational characteristics, location (relative to the population of the community in which the facilities exist), and type of ownership.
2) Estimation and application of this model to determine the change in costs relative to changes in characteristics, the services provided and the ownership structures.
3) Use of the estimated results to determine if economies of scale have been reached in the industry in Montana.
4) Projection of added expenses to the State incurred from subsidizing small relatively costly nursing home facilities.

The ownership structure is tested to determine how it affects costs. The Montana industry is composed of proprietary, government (county) and charitable facilities. The costs differences are determined for the two categories of profit (proprietary) and non-profit (church, government) facilities. The main emphasis is placed on the

test of the hypothesis that costs differ because of the different incentives for provision of care that exist between the two types of facilities.

This study also examines the influences of facility location on cost of operation. In particular, potential cost differences between rural and non rural areas are analyzed. The hypothesis that higher costs are found in rural areas is tested. It is believed that in the smaller communities the awareness of the conditions in the home and the personal acquaintances that exist between the employees, patients and families do affect the cost structure.

Finally, the research analyzes the relationship between costs and size. An analysis is conducted to determine if economies of scale have been reached in such categories as salaries, operation expenses, nursing services and total costs.

Demand for Long-Term Care

In 1972, for the first time, Medicaid expenditures for nursing home care exceeded payments for surgical and general hospitals in the United States. This amounts to $2 out of every $3 of revenue received by nursing homes.[1] The demand for public support is expected to

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[1]"Nursing Home Care in the United States: Failure in Public Policy", Introductory Report. Subcommittee on Long-Term Care of the Special Committee on Aging, United States Senate, U. S. Government Printing Office, November 1974, pp. 1-7.

continue to increase because the fastest growing population group in the U. S. is the age group of 75 years and over.

In the past half century the percentage of older citizens in the U.S. has more than doubled with the present population of people 65 and older approaching the ratio of 1 to 10. Life expectancy has increased from 43 years in 1900 to 73 years at the present. By the end of this century it is expected that the number of Americans age 65 and over will approach 32 million.[2]

In recent years the population in the age group of 65 to 74 has ranged from 12.5 million in 1970 to 13.2 million in 1973, a 1.9 percent increase. In the age group of 75 and over the population ranges from 7.6 million in 1970 to 8.1 million in 1973, a 2.2 percent increase. Over the past ten years (1960-1970 the last census period) these age groups increased 1.2 percent and 3.1 percent respectively. The age group of 65 to 74 made up approximately 6.1 percent of the population in 1960 and also in 1970 (approximately 11 million in 1960 to 12.5 million in 1970). The 75 and over age group made up 3.1 percent of the population in 1960 and increased by 3.8 percent by 1970 (approximately 5.5 million in 1960 to 7.6 million in 1970).[3]

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[2]Simmons, Leo W. The Aged Ill. Appleton-Century-Crofts, Educational Division/Meredith Corp., New York, 1970, pp. 3.

[3]U.S. Bureau of the Census, Statistical Abstract of the U.S., 1974, pp. 31-33.

All of these statistics show that the older citizen in the U.S. is indeed a growing force. This force requires and demands services and aids of a special character which society has not been accustomed to providing. These services are in such areas as transportation, housing, financial aid and health care. To aid the reader in understanding the problems of providing long-term health care, a brief history of the nursing home industry follows.

History of the Industry

Facilities built to take care of the elderly have been discovered as far back in history as the pre-Renaissance period. As the Church became the main overseer of health care, hospitals and facilities for health care could always be found in cities where the large cathedrals were located. It was in the Renaissance period that the first institution that would later become the nursing home was developed -- the almshouse.[4]

The almshouse -- also called the poor farm, the county infirmary or the workhouse -- acted as a catch-all institution, housing orphans, diseased prostitutes, the blind, and other moral deviant and mentally distressed persons as well as the aged. The common denominator of the inhabitants was their dependence on the state for support

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[4] Schneeweiss, Stephen, Nursing Home Administration. University Park Press, Baltimore, 1974, p. 1.

and their rejection by society. The passage of the English poor law enhanced the poor conditions in the almshouse even more (although it placed the responsibility on society to maintain the homes) by using the institution as a warning to everyone that idleness and lack of control in financial matters would not be tolerated by the state.[5]

These same general ideas were carried across the sea with the founders of our nation. The settlers established the almshouse to care for the undesirable, unwanted, and unfortunate of the early pioneer society. But one interesting fact that came about in the young society was the treatment settlers received when they suffered economic loss from Indian raids. Instead of having to go to the almshouse, they were given financial help by the community. This charitable deviation from the norm proved to be a significant step in reversing the errors of the almshouse.[6]

By the 1800's there was an increasing growing concern to improve the conditions which the poor faced. One of the main actions was to provide special care for particular groups which were previously confined to the almshouse. The objective was to develop a variety of institutions. Beginning in 1832 special attention was

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[5] McArthur, Ray F. "The Historical Evolution From Almshouse to ECF". Nursing Homes, Vol. 19, No. 4, 1970. p. 27.

[6] Schneeweiss, op. cit., p. 2.

given to the young blind. They were removed from the stifling atmosphere of the almshouse and placed in an institution of their own, receiving special training and aid. This led to the establishment of other facilities which could provide special treatment and specialized aid and training for such groups as the orphans, widows, veterans and other groups who were previously outcasts of the community. The discovery of the causes and cures for many communicable diseases also decreased the population of the almshouses by giving people who were once considered a deadly entity to the community a new start. All these changes had the effect of "skimming off" the people who had relatively solvable problems, leaving only the individuals for which society had no answers.[7]

The shift of the almshouse's population from a variety of aged and disadvantaged people to one of a highly concentrated type continued up into the 1930's. The almshouse became more and more a place where only old people were sent when their care became troublesome. But the almshouse, as it existed, had a short life left. In 1932, the Federal Government took the responsibility of providing for the poor, relieving much of the burden that was placed on the local governments. It was this shifting of responsibility, along with the

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[7] McArthur, op. cit., p. 26-27.

Social Security Act of 1935, which signalled the demise of the almshouse.[8]

With the creation of the Social Security Act, people were removed from the public institutions and brought back into the private sector--exactly opposite of the previous community goals. This shift was caused by the sudden awareness that local tax money could be saved by such action. To the surprise of the official agencies trying to place the people, unexpected aid was located in the private sector.[9]

A large proportion of the private aid was created by the economic conditions of the country. It was in the middle of the depression, with jobs and money both scarce. Many of the people affected were the ones who had large amounts of capital locked up in the ownership of their large homes. To protect themselves from further losses or even sale of their property, many individuals opened up their homes to the almshouse residents realizing the opportunity for increased income. The residents who were eligible for the Federal aid welcomed the chance to get out of the almshouse and into a more socially accepted existence. Finally, many of the almshouses closed down as

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[8]Ibid, p. 27.

[9]Ibid, p. 27.

this initial start of the nursing home industry started to flourish across the country.[10]

As the industry grew, so did the problems that existed with it. The difference between the initial homes that were established and the homes that came into existence in the late 30's and early 40's was marked. The investors in the later homes soon realized that the method of payment not only provided no incentive to provide proper care, but also discouraged any aid beyond the minimal requirements to exist.[11] As the industry continued to grow, the government finally stepped in with regulations intended to increase quality of care.

The first count of nursing homes was conducted in 1939 by the Bureau of the Census. It revealed that there were approximately 1200 nursing, convalescent and rest homes with approximately 25,000 beds.[12] By 1954, there were 25,000 homes with more than 450,000 beds. These homes provided all types of care, ranging from boarding home care to intensive nursing care.[13]

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[10] Ibid, p. 27.

[11] Ibid, p. 27.

[12] Block, L. "Hospital and Other Institutional Facilities and Services, 1939." Vital Statistics - Special Report, Vol. 13, Nos. 1-57, U.W. Bureau of the Census, Washington, D.C. 1942.

[13] Division of Hospital and Medical Facilities: The Nation's Health Facilities, Ten Years of the Hill-Burton Hospital and Medical Facilities Program, 1946-56. PHS Pub. No. 616, U.S. Dept. of HEW, Washington, D.C., 1958.

Today there are more than 22,000 nursing and related homes in the U.S. There are approximately 12,800 nursing care homes (a facility in which over 50 percent of the residents receive nursing services and at least one R.N. or L.P.N. is employed more than 35 hours a week), 3,560 personal care homes without nursing care (a facility in which 3 or more personal services - eating, walking, bathing, etc. - are provided but not nursing services), and 190 domiciliary care homes (a facility in which less than 3 personal services are provided and no nursing care).[14]

There are more than 917,700 beds in nursing care and related homes today. This accounts for more than 3/4 of the total number of beds of all kinds for the care of the chronically ill and aged. There are also more than 283,890 beds available in other types of nursing care and related homes.[15]

A look at the ownership structure reveals that an estimated 75 percent of the nursing homes are operated under proprietary control with the rest under control of the government or some other non-profit entity. It is also estimated that proprietary homes have approximately 71 percent of the beds and 70 percent of the residents with an average

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[14] "Nursing Care and Related Homes" Health Resource Statistics. Health Services and Mental Health Administration, U.S. Dept. of HEW, Washington, D.C., 1974, p. 382.

[15] Ibid.

size home having 70 beds. The non-profit homes have the balance of the beds with an average size of 88 beds.[16] The services and costs vary, depending on the home, location, and type of ownership. The national expenditures for nursing home care rose from 1.1 percent of national health expenditures in 1950 to over 4.2 percent in 1969. Expenditures for nursing home care in actual dollars increased from $142 million to $2.84 billion, a 1,902 percent increase.[17]

The industry hires over 567,710 persons full-time. A breakdown analysis shows that there is approximately one full-time employee for every two patients. They consist of R.N.'s, L.P.N.'s, aids and orderlies, housekeepers, bookkeepers, and administrators.[18]

The number of homes in Montana has kept pace with national trends. In 1967 there were approximately 82 nursing homes in Montana. This number consisted of 45 nursing care homes, 20 personal care homes with nursing care, 15 personal care homes without nursing care and 2 domiciliary care homes. The number of residents in the facilities was 2,838. The facilities employed a total of 1,380 full-time employees.[19]

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[17] Rice, Dorothy P., and Barbara Cooper, "National Health Expenditures, 1929-1970", Social Security Bulletin, Vol. 34, January, 1971.

[18] "Nursing Care and Related Homes" Health Resources Statistics. p. 382.

[19] Ibid, 1969. pp. 269-281.

By 1971, the industry had grown to 103 homes, a 26 percent increase. This total consisted of 61 nursing care homes (36 percent increase), 27 personal care homes with nursing care (35 percent increase), 13 personal care homes without nursing care (13 percent decrease), and 2 domiciliary care homes (no change). The total number of residents in the facilities rose from 2,838 to 4,145, a 46 percent increase. The number of full-time employees increased 60 percent, from 1,380 to 2,201.[20]

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[20] Ibid, pp. 281-400.

Chapter 2

ECONOMIC THEORY OF COST

It is important to understand the economic concepts behind total, average and marginal costs in order to interpret any analysis of nursing home costs in Montana. These concepts are presented at the beginning of this chapter. Related studies are discussed in the second part of the chapter in an attempt to clarify the estimation techniques and economic theory used for this study.

Total Cost Curves

The starting point of a facility's cost structure is its total cost function. This function states the total cost of producing a given number of patient days of care in a certain time period. The function takes the following form:

$$TC(q) = f(q) + b$$

TC = Total Cost

q = number of patient days of care

b = fixed costs

The total cost function (TC) consists of costs incurred from producing "q" patient days of care plus total fixed cost "b".

The fixed cost is defined as the total cost incurred when "q" equals zero. It remains constant over all ranges of "q". The total variable cost is defined as the difference between total cost and

total fixed cost.

$$TVC\ (q) = TC\ (q) - TFC\ (q)$$

In other words total variable cost is the portion of total cost which changes with changes in the number of patient days of care "q". Curves representing total cost, total variable cost and total fixed cost are shown in Figure 1.

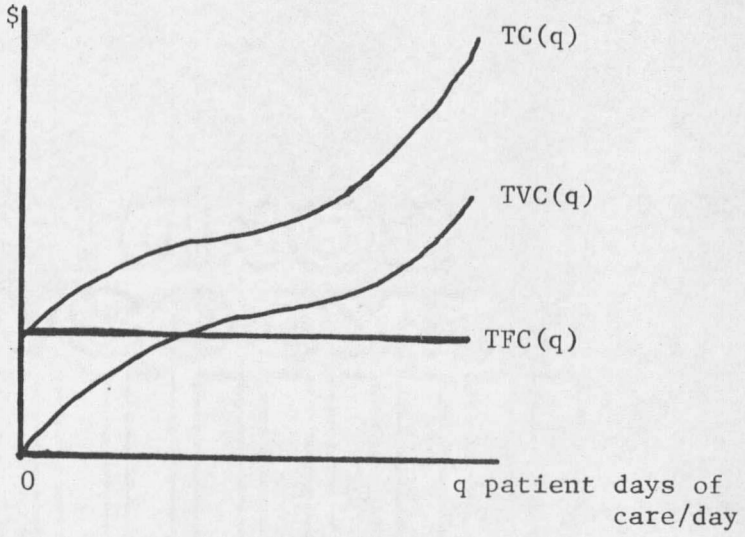

Figure 1. Total Cost Curves

Average Cost

Average cost can be broken down into two components, average variable cost and average fixed cost. Average variable cost is defined as total variable cost divided by the number of patient days of care "q".

$$AVC(q) = \frac{TVC(q)}{q}$$

For each unit of a variable input, output (q) increases. Ordinarily it increases at an increasing rate for the initial increments in variable inputs due to the positive effects which the additional units of inputs have on the productivity of the existing units of inputs. This means that the average variable cost is decreasing per patient day of care. However, as the amount of variable input continues to increase, the strength of this positive effect decreases and eventually becomes negative and output increases at a decreasing rate. This implies that average cost is increasing per patient day of care (Figure 2) as the number of patient days produced becomes larger.

Average fixed cost is defined as total fixed cost divided by the days of care "q".

$$AFC(q) = \frac{TFC(q)}{q}$$

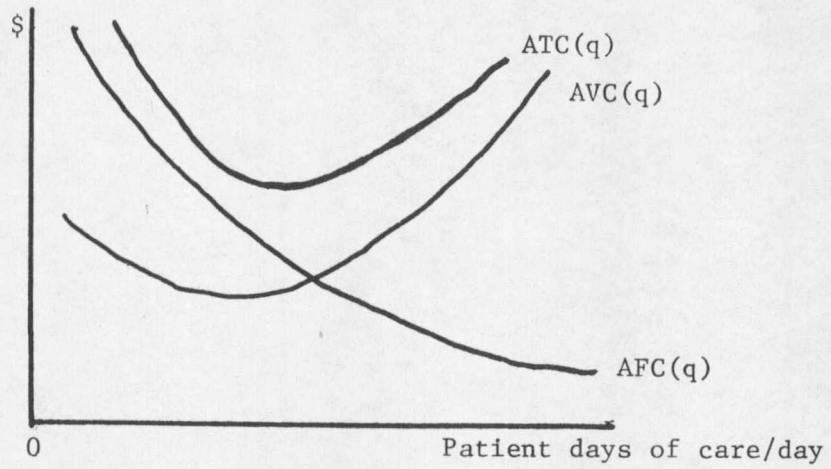

Figure 2. Average Cost Curves

Average fixed cost decreases continuously over the range of output (Figure 2). This is explained by the fact that total fixed cost remains constant over all levels of patient days of care. Average fixed cost is represented by the AFC(q) curve which approaches asymptotically both the vertical and horizontal. The curve markes AVC(q) represents average variable cost, first decreasing and then increasing as patient days of care provided in any given facility increases.

Marginal Cost

Marginal cost represents the change in total cost with respect to a unit change in output. The marginal cost function is stated as follows:

$$MC(q) = \frac{d}{dq} TC(q)$$

Mathematically, marginal cost is the derivative of total cost with respect to output "q" (Figure 3).

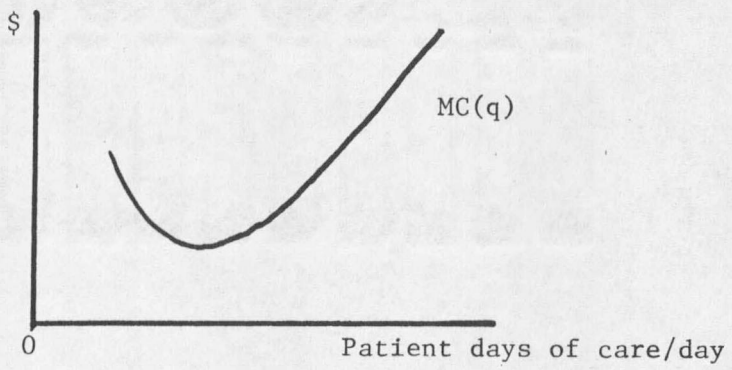

Figure 3. Marginal Cost Curve

Technically, the marginal cost curve represents the slope (rate of change) of the total cost (or total variable cost) curve as output increases from zero.

Figure 4 graphically shows how average and marginal cost are related. Average and marginal costs are equal when average cost is at a minimum.* Average cost multiplied by the number of patient days

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*Proof

1) Set derivative of average cost = 0

$$\frac{d}{dq}\ \frac{TVC}{q} = 0 \quad \text{AVC is at a minimum}$$

This equals:

$$\frac{q\frac{d}{dq}\ TVC - TVC}{q^2} = 0$$

2) To solve, the numerator must equal 0

$$q\frac{d}{dq}\ TVC - TVC = 0$$

This is the same as

$$q\ MC - TVC = 0$$

which equals

$$MC = \frac{TVC}{q}$$

Which is the same as

$$MC = AVC$$

∴ When average variable cost is at a minimum, it equals marginal cost.

of care "q" equals the total cost of care. Marginal cost indicates the rate of change in total cost.

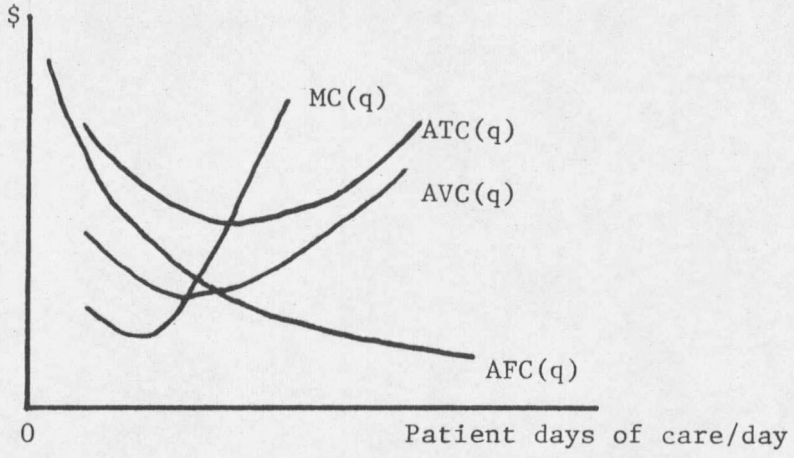

Figure 4. Marginal and Average Cost Curves

It is hypothesized that average cost will change as the selected characteristics of the long-term care facility change. The model developed in this study will be used to test specific hypotheses about the relationship between facility characteristics (ie, facility size, ownership structure, etc.) and average costs. An attempt will be made to determine a least cost facility size. In order to accomplish this objective, the concept of long run cost must be understood.

Long Run Cost

In the theories stated above, variable and fixed costs are discussed. By definition, fixed cost remains constant over all output, while the variable cost increases as output increases. In the long run

all inputs (labor, capital, technology, etc.) and costs are variable. The relationship between the input mix and the total production of the facility is described by the concept of "returns to scale."

There are three types of "returns to scale"; decreasing, increasing and constant. Increasing returns to scale (economies of scale) are closely related to indivisibility of input units. In general, this means that productive equipment is available in a definite range of sizes. As the facility expands its output it moves from operating on a small scale to a larger more efficient operating size. Also, as the facility expands, specialization has a positive effect on productive returns. When a facility is experiencing increasing returns to scale (that is the percentage change in patient days of output is greater than the percantage change in inputs) long run average cost is decreasing.

Increasing returns to scale cannot last forever. At some point of production the percentage change in output will equal the percentage change of input. This is known as constant returns to scale. At this production level, long run average cost is at a minimum point.

Eventually decreasing returns to scale (diseconomies of scale) may set in. At this point of production, due to inherent inefficiencies of large scale operation, the percentage change in output is less than the percentage change of input. Long run average cost is increasing.

Using these concepts a least cost facility size can be determined.

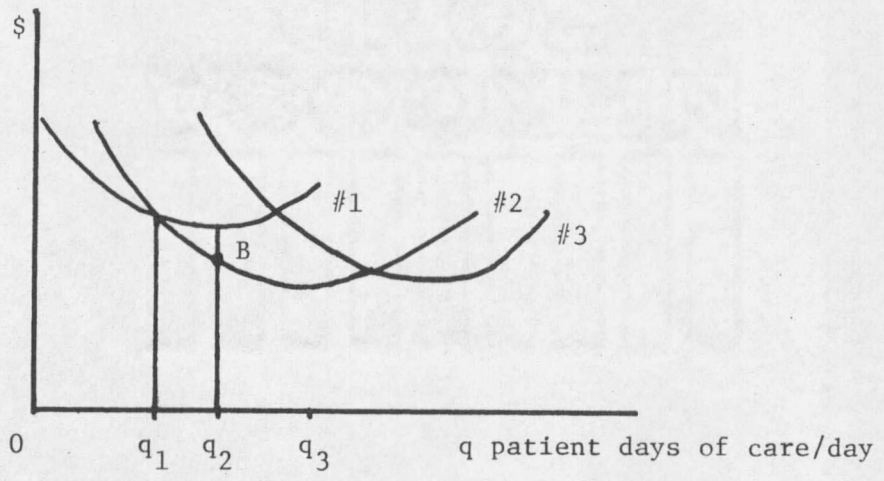

Figure 5. Short run average cost curves for three different facility sizes.

Three short run average cost curves are shown in Figure 5. Each represents the short run average variable cost of a different size facility. Curve #1 represents the variable cost of the smallest facility. Due to increasing returns to scale, the larger facility, size #2, has lower average variable cost, curve #2. Facility #3 is still larger and its average variable cost is higher (curve #3); the effect of decreasing returns to scale.

It can be seen that a facility of size #1 will be built if the expected patient days of output is between 0 and q_1. If output is expected to be approximately q_3, the facility of size #2 will be built. It can also be seen that if output is at q_2, (minimum average cost for facility #1) benefits could be gained by increasing facility

size to that of facility #2, thereby lowering costs (point B). This proposition can be generalized:

> When there are increasing returns to scale, the minimum cost of any output can be obtained by operating, at less than its capacity, a facility that is larger than the facility whose own minimum cost corresponds to the output in question.[21]

Now, assume that the facility has the option to continuously adjust facility size upward. This would generate many short run average cost curves, as shown in Figure 6.

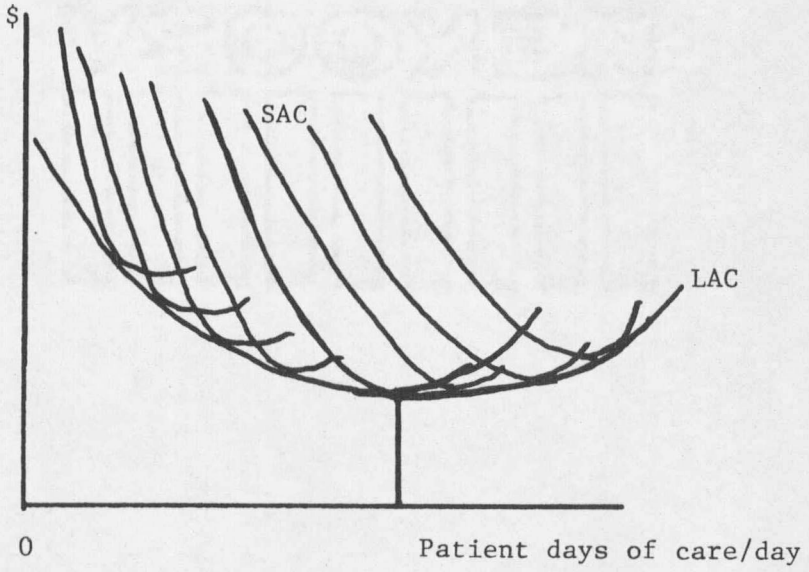

Figure 6. Long Run Average Cost

Each one of the short run cost curves (SAC) represents a different size facility. A line drawn tangent to all the curves gives the long

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[21] Ibid, p. 174.

run average cost curve (LAC). The short run and long run average cost curves are tangent at each other's minimum point only when constant returns to scale exist. When LAC is declining, it is tangent to the SAC to the left of their minimum points. When the LAC is rising, it is tangent to the right of the SAC minimum point.

The firm does not build all possible facility sizes to determine cost structures. In deciding what size facility to build, a survey is made of the range of minimum costs. These are determined by experience and/or research. The facility should then be capable of making a fairly reliable estimate of least cost facility size. For this reason the LAC curve is often called "the planning horizon" of the facility.

This study will attempt to determine a least cost long-term care facility size. This requires that the relationship between cost and size can be expressed as a cost minimizing function. The results will be analyzed to determine cost savings to the state, public and patients.

Empirical Cost Research

Various studies have been conducted to determine short run average cost of nursing home facilities. One such study will be used as a basic guide for this research. The study was conducted by Hersch S. Ruchlin and Samuel Levey on homes in the Commonwealth of Massachusetts

as part of extensive research on nursing home care in Massachusetts.[22]

Their study was conducted on data covering the period from 1965 to 1969. The data was pooled and an aggregate regression equation was run setting operating costs per patient day as dependent variables and characteristics (size, ownership, age, percent public patients, etc.) as independent variables. Three alternative cost-size relationships were used for the regression equations. They consisted of a linear model, a parabolic model and a rectangular hyperbola model.

The Ruchlin-Levey study hypothesized that a positive relationship existed between cost and public (or charitable) homes as compared to private homes. The ownership variable was studies to determine if a difference existed between charitable and proprietary controlled homes. They hypothesized that the absence of a profit motive in the charitable homes leads to greater expenditures per patient (increased costs). An analysis of their findings revealed that there is a positive relationship between ownership type and cost. Charitable organizations generally have higher cost than proprietary organizations in all categories except for salaries, supplies, recreation, and property costs, where there is no relationship noted, except for property costs which are negatively related to charitable ownership. Their findings are supported by another study (conducted in 1972) in which the average total

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[22] Ruchlin, Hersch S., Levey, Samuel, "Nursing Home Cost Analysis: A Case Study". Inquiry, Vol. 9, No. 4, September 1972, pp. 3-15.

cost per resident day was higher in non-profit homes ($17.71) than in proprietary homes ($14.86).[23]

Under proprietary control, the Ruchlin-Levey study showed that costs are lower in almost all categories. This fact is used in discussion by charitable organizations concerning the quality of care received in proprietary homes. The implication is made that costs are lower not because the homes are run more efficiently, but because corners are being cut to increase profits. The main problem with the complaint is that no scale has been devised (or at least one that is widely accepted) which measures the quality of care to cost ratio.

Another study conducted in Minnesota concluded that no statistically significant differences in quality of care exist between proprietary and nonproprietary institutions. The study concluded that the qualities of administration and the characteristics of the employees explain variation in quality of care better than structural variables, including ownership.[24]

A different study (conducted in 1975) states that there is no support for the belief that proprietary facilities are significantly

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[23] "Selected Operating and Financial Characteristics of Nursing Homes", Vital and Health Statistics, U.S. Department of HEW, Series 13, No. 22, 1975, p. 3.

[24] Sherwood, Sylvia (ed) Long-Term Care: A Handbook for Researchers, Planners, and Providers. Vol 5. Spectrum Publications, Inc., New York, 1975, p. 141.

different in terms of nursing services provided than non-profit homes. It does state that fewer non-nursing employee hours are provided per patient day in proprietary facilities. This study is based on a matched comparison of proprietary and non-profit homes in the State of Washington.[25]

Location in the Ruchlin and Levey study is analyzed but the variable is discounted as an important variable. In their study, they hypothesized that costs would be greater if homes were located in the greater Boston area as compared to the rest of the Commonwealth. The main reason for such a hypothesis is that the cost of living is higher in Boston. From the analysis of their data, they determined that there was no consistent significant relationship between the region variables as specified and cost. Upon this conclusion the variable was considered an unimportant factor in cost determination.

The Ruchlin-Levey study uses the size variable in the determination of economies of scale (increasing returns to scale). The number of beds per facility is used as a measure for the size variable. The models they used state size as having a linear effect, a parabolic effect, and a rectangular hyperbola effect on costs. They

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[25]Winn, Sharon, "Analysis of Selected Characteristics of a Matched Sample of Non-Profit and Proprietary Nursing Homes in the State of Washington". Medical Care, Vol. 12, No. 3, March 1974, pp. 221-228.

hypothesized that economies of scale would show up as a negative signed coefficient in the linear model, a positive signed coefficient in the parabolic model, and a positive signed coefficient in the rectangular hyperbola model.* Their analysis of the models shows that the regression coefficients are practically the same for all variables in all three runs, except for the size variable which changes due to the nature of the models.

The analysis of their linear model results reveals that there is a negative relationship between size and average total cost, but it proves to be statistically insignificant. Analysis of the cost categories (a negative relationship - decreasing cost - indicating economies of scale) reveals the economies of scale hypothesis was supported in six other categories which make up about 80 percent of the total costs. The coefficients of these categories were all statistically significant.

A study conducted by Douglas Skinner and Donald Yett also posed the question of economies of scale (least cost facility size). As did Ruchlin-Levey study, the Skinner-Yett study reported a negative cost-size relationship, but due to differences in methodology, they also reported the existence of a least cost facility size. Due to a

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* These particular models are discussed in chapter 4.

continuous negative cost-size relationship for the size of the institutions represented in their study, Skinner and Yett feel that a least cost size has not been reached and that additional cost savings would occur if larger facilities were constructed. From an analysis of their study, they estimated an "optimal" size institution of 88 beds (given an 83 percent occupancy rate as reported in their study). This estimate is similar to estimates offered by nursing home administrators as reported in a study conducted by Wells (1965, p. 40) and Kottke and Trainor (1968, p. 28).[26]

The Ruchlin-Levey study discusses the implications which are generated from the specifications placed on the size variable. They state that the linear estimation technique relationship does not permit the calculation of a least cost point, but the parabolic specification does. From their study, coefficients from both the linear and parabolic regressions were only significant for three cost categories (depreciation, laundry-linen, and recreation-rehabilitation). But, due to the signs of the regression coefficients, the last two values maximize costs. They explain the cause of this inverted U-shaped cost curve as being either an overstating of the curvature due to the use

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[26] Sherwood, Sylvia, Long-Term Care: A Handbook for Researchers, Planners, and Providers. pp. 148-149.

of the size variable and the size variable squared or due to the lack of reliable and precise data, stating that the cost curves may be the result of observations from cost curves at different quality levels.*

In the Ruchlin-Levey study, the two most important cost categories are nursing and dietary expense (52 percent of the total cost) followed in order by supplies, salaries, property, operations, depreciation, housekeeping, laundry and linen, and others. An analysis of the standard deviations of the mean cost data revealed that many of the cost categories fluctuate within a wide range of their mean values. They believe this was caused by a wide variability in quality and quantity of care rendered and the lack of sufficient accounting requirements.

No current research of this type has been conducted for the nursing home industry in Montana. This research will estimate the average costs relevant to selected characteristics for Montana facilities. The estimation techniques will be similar to that used in related research but the final conclusions will only apply to the industry in Montana. The analysis of the results will focus on determining if the industry in Montana is similar to the industry in other

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* This is explained in greater detail in chapter 4.

parts of the country, and to provide an analytical background for decision analysis. The final results will provide useful information to law makers, administrators and inevestors in the area of nursing home care in Montana.

Chapter 3

DATA

Nursing home cost reports filed with the Department of Social and Rehabilitation Service (SRS) are the source of data for this study. Each home which participates in the medicare-medicaid program is required to file such reports with the Department once a year. The reports consist of a balance sheet, statement of income and expenses, patient statistics and summary, cost per patient day, personnel staff, and charges to private pay patients schedules. Some reports are more complete than others in terms of information provided. Most reports are of the standard form supplied by the SRS and completed by an accountant or an accounting firm.

Permission for access to the cost reports of the private facilities was obtained by means of mail and telephone requests. The cost reports of government owned facilities are public knowledge and can be acquired upon request. Responsible personnel and administrators were informed as to what data was needed and why and assured of confidentiality.

The actual sample size consists of fifty nursing homes. These homes were in the medicaid-medicare program in 1974 (the sample time period). The potential sample size numbers 75 homes.* Of the

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*State institutions and homes not participating in medicare-medicaid

twenty-five homes not in the actual sample, sixteen would not release such information, three had a change of administrators and could not release the preceding administrator's reports, four were still considering the request (time limit prevented further waiting), and two did not have the power to grant permission for release of their cost reports. The actual sample size is 66.7 percent of the potential sample.

Characteristics

The data was compiled and the mean, standard error and range were determined for each cost category. The categories and the results are listed in Table 1. The figures include reports that were filled out as hospital-nursing homes (26 percent of sample) in which costs were not broken down. Comparison of these means with means generated by facilities providing nursing services only, shows four categories significantly different. The cost categories of x-ray, laboratory, administrative and general, and total operating expense are statistically different at an .005 level of significanc indicating lower mean cost for nursing homes. Further analysis of the x-ray and laboratory expense categories shows they are not significantly different from zero for nursing homes. This implies that the average nursing

*continued. are not included in the potential sample (potential sample equals 72.8 percent of total facilities).

Table 1

Expenses Incurred from Operation - Total Sample[1]

Expense Categories	Mean	Standard Error[3]	Range
Employee Health & Welfare	$24,838.00*	4,359.08	183,461.93
Dietary	63,408.74*	6,557.22	263,911.81
Housekeeping	14,977.40*	2,410.48	98,127.00
Laundry & Linen	12,760.58*	2,157.29	90,013.75
Operation & Maintenance	30,013.32*	3,443.42	132,306.68
Medical Supplies	3,254.69*	1,240.59	36,394.73
Pharmacy	6,174.27*	2,191.90	82,202.00
Therapy	3,342.62**	1,418.21	54,518.00
X-Ray	4,493.75[2]**	2,000.70	69.034.93
Laboratory	4,142.44[2]**	1,683.70	50,936.34
Others	23,498.24*	3,489.39	94,498.62
Administrative & General	47,272.00[2]*	5,924.00	189,922.00
Nursing & Supplies	133,336.65*	17,753.33	777,852.87
Total Operating Expense	372,829.00[2]*	44,703.00	1,918,203.00

[1]Data consist of all valid observations for nursing homes and hospital-nursing homes.

* Significant at .005 level.
** Significant at .01 level.

[2]Mean of expense category significantly different for nursing home data alone, at the .005 level;

Category	Mean (Nursing home data)
x-ray	184.87
laboratory	265.02
admin. & gen.	29840.00
Total oper.	344395.00

[3]Standard error = $\frac{\sqrt{\text{variance } (\bar{X})}}{\sqrt{n}}$

homes have little or no expenses in these categories. Therapy expense becomes insignificant at the .05 level and medical supplies and pharmacy at the .10 level indicating that these expenses are not important determinants of total operating cost for nursing homes. Additional analysis of the total sample size shows that therapy and laboratory expenses are statistically different than zero at the .01 level of significance while x-ray expenses become significant at the .025 level. The remaining categories are significantly different from zero at the .005 level (99.5 percent confident).

A breakdown of the cost categories into percentage of total cost is given in Table 2. The three largest cost categories are nursing and supplies, dietary, and administrative and general. They compose 65.5 percent of the total operating costs. Nursing and supplies covers all expenses dealing with nursing services including the cost of aides and orderlies. Dietary expense is composed of all costs dealing with food and kitchen help while administrative and general expense covers cost of administrative activities. A detailed breakdown of these cost categories is presented in Table 3. The smallest contributors to total cost, medical supplies and therapy, only make up 1.8 percent of the total expenses.

Table 2

Percentage Breakdown of Total Operating Expenses

Expense Category	Percentage of Average Total Operating Expense[1]
Employee Health & Welfare	5.7
Dietary	17.0
Housekeeping	4.0
Laundry & Linen	3.4
Operation & Maintenance	8.0
Medical Supplies	0.9
Pharmacy	1.6
Therapy	0.9
X-Ray	1.2
Laboratory	1.1
Others	6.3
Administrative & General	12.7
Nursing & Supplies	35.8
	99.6[2]

[1]Percentage = mean of Expense Category/mean total operating expense.

[2]Not equal to 100 due to rounding error.

Further breakdown of the three largest expenses (Table 3) shows that salaries for the aides and orderlies are the largest expense in the nursing and supplies category while food expense is the largest component of the dietary category. In the administrative and general category salaries for administration purposes are the largest expense followed by interest expense. Depending on the age of the nursing home and how the construction was financed, interest expense varies (with a range of $63,000.00) from home to home.

Looking at the category of nursing and supplies expense shows that the average number of aides and orderlies per home is 42.7 with a range going from 10 to 96. They work, on the average, 30,509 hours per home receiving an average gross salary of $71,723.44 per home. This means the average aide or orderly works 714.5 hours per year at a wage rate of $2.34 per hour. The average number of registered nurses working per home equals 6.3 ranging from a minimum of zero to a maximum of 18. The average gross hours worked per home is 5,843.3 with the gross wages averaging $25,062.15 per home. The average wage rate per registered nurse is $4.29 with the average work time equal to 927.5 hours per year. The average number of licenses practical nurses per home is 4.9 with the mean gross hours worked per home equal to 5,391.9. The average gross salary is $16,597.79 per home, resulting in a wage rate of $3.08 per hour with the average L.P.N. working 1,100 hours per year. The number of L.P.N.'s per home ranges from zero to a maximum of 14. A breakdown

Table 3

Breakdown of Nursing Service and Supplies, Administrative and General, and Dietary Expense Categories

Nursing & Supplies

Percentage of total operating expense 35.8 Category	Percentage of average nursing & supplies
Salaries - R.N.	14.8
Salaries - L.P.N.	11.8
Salaries - Aides & Orderlies	46.2
Supplies	2.7
Others[1]	24.5
	100.0

Dietary

Percentage of total operating expense 17.0 Category	Percentage of average dietary
Salaries	46.6
Food	49.0
Supplies	2.9
Others[1]	1.5
	100.0

Administrative & General

Percentage of total operating cost 12.7 Category	Percentage of average administrative & general
Salary - Administrative	36.7
Salary - Office	13.3
Office, Supplies	4.6
Telephone - Telegraph	2.8
Vehicle	1.0
Travel	1.9
Advertising & Public Relations	0.5
Licenses & Dues	1.6
Professional Service	7.5
Interest	23.9
Miscellaneous	6.2
	100.0

[1]Consist of costs that would not fit given categories.

of the personnel categories is listed in table 4.*

The size of the nursing home is determined by the number of licensed skilled nursing care beds (SNC) plus beds licensed as intermediate care A, care B, and boarding home care. Table 5 lists the types of licensed beds, giving the average number per home, actual patient days, and percent of occupancy.** It is noted that the average number of licensed boarding home care beds is almost insignificant. This can be explained by the fact that the sample consisted of only two homes with licensed boarding home care beds. The table also gives the cost per patient and the charge per patient day (private pay patients).*** The cost per patient day for SNC for the nursing home data is significantly different than that of the total sample, averaging close to $13.50. The means of the other costs are relatively the same for either data set.

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*Due to the lack of completed personnel wage and hours worked forms, these figures are based on a sample size of 12 homes. The data consist of full-time and part-time help.

**In some facilities the occupancy rate for a certain type of licensed bed may exceed 100 percent. This is explained by the fact that the facility is providing more patient days of service than the actual number of licensed beds can provide (ie., patients in beds licensed as intermediate care A receive SNC care).

***Cost per patient day equals total cost of providing care for a type of bed/total number of patient days reported for each type of bed.

Table 4

Personnel*

Job Title	Average # 1 home	Range
Housekeepers	4.3	0-14
Kitchen-Dietary	11.1	4-21
R.N.	6.3	0-18
L.P.N.	4.9	0-14
Aids-Orderlies	42.7	10-96
Laundry	2.3	0-11
Managers	1.2	0-4
Maintenance	1.5	0-6
Bookkeeper-Med. Records	2.1	0-10

*Sample size = 12, all categories include full-time and part-time help.

Table 5

Average Size, Cost per Day, Charge per Day in Total Sample[1]

	Mean	Std. Error[4]	Range
SNC			
Lic. Beds	30.9	5.13	229
Actual Patient Days	8991.5	1803.5	81,373
Percent Occupancy	79.9	5.56	117.2
Intermediate Care A			
Lic. Beds	14	2.38	78
Actual Patient Days	5786.4	895.3	32,034
Percent Occupancy	113.2	9.17	298.2
Intermediate Care B			
Lic. Beds	3.79	1.2	36
Actual Patient Days	1978	437.6	13,021
Percent Occupancy	142.9	6.29	170
Boarding Home Care			
Lic. Beds	18.1**	1.75	86
Actual Patient Days	618.4**	603.4	29,573
Percent Occupancy	93.6	2.7	100
Cost			
Cost/patient day - SNC	16.21[3]	1.35	30.99
Cost/patient day-Int. Care A	14.03	1.84	74.99
Cost/patient day-Int. Care B	5.99	1.0	19.5
Cost/patient day-Boarding Care	.50*	136	14.42
Charge (private day patient)			
Charge/day - SNC	17.92	.475	12.27
Charge/day- Int. Care A	15.51	.424	12.39
Charge/day - Others[2]	12.42	.715	10.59

[1]Data consist of all 49 valid observations, nursing home and hospital-nursing homes.

[2]Others = Int. Care B + Boarding Home Care.
* Significant at .10 level.
**Insignificant value (do not reject null hypothesis of mean = 0)

[3]The difference between the mean of the complete data sample (hospital-nursing home + nursing homes) and just nursing home data is significant at the .01 level.

[4]Standard error = $\frac{\sqrt{\text{variance } (\bar{X})}}{\sqrt{n}}$

A crosstabulation between ownership and number of licensed beds is given in Table 6. The homes are classified as either profit or non-profit, nursing home or nursing home-hospital. The number of beds per home are put into relative ranges. The number of homes in each range is also given.

Table 7 shows the relationship between ownership and total operating expense. The observations are put into ranges determined by their total operating expense. The percentage of each type of home within the range is also given. Inspection of the table reveals that government homes comprise 50 percent of the homes in the expense ranges of $100,000 to $150,000 and $400,000 to $450,000. Of all the homes with over $450,000 expenses, government homes lead the way with over 36 percent of the facilities in that range. Further analysis shows that 26.6 percent of all government nursing homes are in that range.

Analysis of other relationships using ownership type as the base show that 50 percent of the profitable corporate owned homes make over $10,000 net profit per year. This accounts for over 33 percent of the homes in that range. Over 78 percent of the non-profit government homes make under $100 net profit per year (could be negative). This comprises 55 percent of the homes in that range. Fifty-seven percent of profitable individually owned homes are in the range of $10,000 or over net profit while only 7.1 percent of the non-profit government

Table 6

Crosstabulation Between Ownership and Licensed Beds[1]

Type	Type of Beds							
	SNC		Intermediate A		Intermediate B		Boarding	
	#	Range	#	Range	#	Range	#	Range
Non-Profit/ Church	1	0-10	1	0-10	1	0-10	3	0-10
	1	30-40	2	10-20	2	20-30	1	Over 70
	1	40-50	1	30-40	1	30-40		
Non-Profit Assn.	1	50-60						
	1	20-30	1	20-30	1	0-10	1	0-10
Non-Profit Govt.	3	0-10	7	0-10	14	0-10	14	0-10
	4	30-40	2	10-20				
	4	40-50	3	20-30				
	2	50-60	1	30-40				
	1	Over 70	1	Over 70				
Proprietary/ Individual	4	0-10	4	0-10	4	0-10	7	0-10
	2	10-20	2	20-30	2	10-20		
	1	30-40	1	30-40	1	20-30		
Proprietary/ Partnership	1	20-30	1	40-0	1	1 - 10	1	0-10
Proprietary/ Corp.	2	0-10	4	0-10	7	0-10	8	0-10
	3	30-40	1	10-20	1	10-20		
	2	50-60	1	20-30				
	1	Over 70	2	30-40				
Non-Profit Assn.*	2	0-10	5	0-10	8	0-10	8	0-10
	4	10-20	2	10-20				
	1	20-30	1	20-30				
	1	30-40						
Non-Profit/ Gov't. H-N*	1	0-10	3	0-10	5	0-10	5	0-10
	2	10-20	2	10-20				
	2	20-30						
Proprietary/ Corp. H-N*	1	0-10	1	0-10	1	0-10	1	0-10

[1] Insufficient information for one home, sample size = 49.
* H-N = Hospital - Nursing home.