NIOSH

Costs and Benefits of Occupational Health Nursing

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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COSTS AND BENEFITS
OF
OCCUPATIONAL HEALTH NURSING

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Cambridge, Massachusetts 02140

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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ABSTRACT

A study of the costs and benefits associated with occupational health nursing programs was conducted through a program that included selection of matched pairs of small manufacturing plants where one plant had a nurse and the other did not have a nurse. Four pairs of plants were selected from the following industries: clothing, electronics, processing machinery, and textiles. Surveys were conducted at each plant to collect information related to costs and benefits of having or not having an occupational health nursing program over a three year retrospective period of time. For each pair of plants, a case study was developed which described the plants and compared direct and indirect costs and benefits associated with occupational health nursing programs.

The results of this study show that an occupational health nursing program can provide a substantial economic benefit to employers in small plants as well as to employees. Less benefit from a nursing program was found in small plants which were considered to have few occupational hazards or which had developed cost-effective alternatives for the delivery of occupational medical care. The study concludes that plant managers should pay greater attention to costs associated with employee illness and injury.

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INTRODUCTION

Little work has been done from the managerial perspective toward evaluating the nature of the relevant costs and benefits of occupational safety and health programs, even though benefits in improved employee morale, increased efficiency and productivity, and reduced costs for lost-time and medical treatment have been commonly acknowledged. Determining the current or potential value of occupational safety and health programs is particularly difficult for managers in small manufacturing plants with less than 500 employees. They are hampered by a lack of staff resources, insufficient data, and an overall lack of appreciation for the potential financial benefits associated with well-administered occupational safety and health programs.

This study was undertaken to develop basic information regarding the costs and benefits of occupational safety and health programs. The study focuses on the costs and benefits of occupational health nursing services because they are, typically, the core of occupational safety and health programs in small plants. The methodology for conducting this study included the development of case studies of matched pairs of plants consisting of one plant with an occupational health nursing program and one plant without such a program.

Specifically, 4 pairs of manufacturing facilities were selected based upon the following criteria:

- The plants were small (less than 1000 employees) and pairs were comparable in size.
- All plants were from a single state to provide comparability under state regulations for workers' compensation.
- All pairs of plants were matched according to their Standard Industrial Classification and the nature of their manufacturing process to provide comparability of potential hazards.

Representatives of plants considered for participation in this study were contacted to discuss the suitability of their plant for inclusion and their willingness to cooperate. The final sample of 4 pairs of plants was drawn from the following industries:

- SIC 3554: Processing Machinery
- SIC 3679: Electronics
- SIC 2299: Textiles
- SIC 2253: Clothing

Data were collected through a combination of site surveys, interviews with plant personnel, and follow-up telephone contact to verify preliminary data and to collect additional information. The results of the data collection effort were compiled into case studies for each matched pair of plants. These case studies provide the basis for evaluating the costs and benefits of occupational nursing programs from the perspective of plant management.

Table 1 describes the final sample of 4 pairs of plants according to several criteria including:

- Presence or absence of a nurse.
- Average size of the hourly or production employee work force.

- Average annual OSHA Log case rate.
- Average annual lost-time case rate.
- Average duration of lost-time cases.

A comparison of these rates suggests a favorable performance in the plants with nurses, except for the average duration of lost-time cases. It should be noted, however, that the average duration may be increased because the nurse has helped to reduce the frequency of the less serious cases. This data is also susceptible to the effects of a few cases of long duration.

TABLE 1

SUMMARY OF PLANT CHARACTERISTICS*

Pair	Industry	Nurse	Average Hourly Work Force Size	Average Annual Rate Per 100 Hourly Employees		Average Days/ Lost-Time Case
				OSHA Log Reports	Lost-Time Cases	
A	Machinery	Yes	293	39.0	11.5	13.1
		No	309	62.3	17.9	9.2
B	Electronics	Yes	244	11.3	3.7	11.4
		No	279	18.9	6.0	13.4
C	Textiles	Yes	346	21.3	8.5	19.1
		No	249	23.0	5.2	15.8
D	Clothing	Yes	247	6.4	3.2	25.0
		No	282	10.0	2.7	5.5

*Averages over 3 years: 1976-1978; in this study "hourly" is used interchangeably with "production" in contrast to "salary" or "administrative/clerical" personnel.

OCCUPATIONAL SAFETY AND HEALTH PROGRAMS AND THE OCCUPATIONAL HEALTH NURSE

The scope of occupational safety and health programs varies widely and is affected by a number of different factors including:

- Size of the plant: There is a general trend toward increasing sophistication of occupational safety and health programs as the size of the plant work force increases. Some corporations have formal personnel policies which require that nurses and/or physicians be hired when plant size exceeds a specific level.
- Nature of the hazards: Companies in heavy industry or those which deal with hazardous substances have a greater tendency to develop occupational safety and health programs.
- Historical incidence of injury and illness: As severity and frequency rates of injury and illness increase, there is a greater incentive for the development of occupational safety and health programs.
- Management policies: Some plants have developed comprehensive programs in conjunction with employee benefit programs.
- Program staff skills: The professional skills and interest of existing occupational safety and health personnel can influence the further development of specific programs.
- Trends within industries or regions: Remarkable similarities in the scope of occupational safety and health programs have been observed within specific industrial categories where there is little or no apparent correlation with other factors such as employment size or the nature and degree of hazards.
- Regulatory requirements: OSHA requirements for medical surveillance and monitoring for specific occupational hazards can become a major force behind the development of occupational safety and health programs.

The scope of occupational safety and health programs ranges from sophisticated in-plant medical facilities with full-time staffs including physicians, nurses, and other health professionals to first aid services provided by supervisors, security guards, or personnel managers. Even among small plants, considerable variation may be found.

Some professional health organizations have formulated guidelines for the development and management of occupational safety and health programs, but little work has been done to evaluate these programs in terms of their costs and benefits. The result is that the criteria for program design and staffing are based upon a largely intuitive body of knowledge which is unsupported by quantitative evaluations. An example of the intuitive approach is a common rule of thumb that occupational nursing services should be provided at the rate of 1 hour of nursing service per day per 100 employees. A hypothetical application of this rule for a plant with 300 employees would result in a requirement of 15 hours of nursing service per week. This calculation does not necessarily mean that a full-time nurse would not be beneficial. On the contrary, it is only suggestive that, based on the size of the employee population, 15 hours of nursing service per

week (i.e., care for occupational and nonoccupational illness and injury based on medical directives) would be fully utilized. To justify the cost of the additional 25 hours per week for full-time employment status, this approach requires that the nurse function at several levels of activity and assume responsibilities beyond the specific role of primary nursing care such as:

- Health promotion and disease prevention.
- Hazard surveillance and control.
- Review and control of lost-time and medical care costs.
- Compliance with state and Federal occupational safety and health regulations.
- Administration of health insurance programs, records, and reporting systems.

An adjunct to this rule of thumb says that the services of a plant physician should be provided at the rate of about 1 hour per week per 100 employees. This service, which is utilized for conducting physical examinations and providing consultation or follow-up for long-term disability cases, is usually provided on a part-time basis in small plants.

The requirements for occupational health and safety programs vary greatly within industry and flexibility is essential in the design of the most effective program for an individual plant. Recent developments such as the health maintenance organization (HMO) and the independent practice association (IPA) provide promising sources for occupational medical care. In the future, efforts by industry to control health care costs will prompt additional development of these and other alternative systems; however, it is likely that the occupational health nurse will remain the predominant focus for delivery of health care in the small plant environment.

THE VALUE OF OCCUPATIONAL HEALTH NURSING PROGRAMS

INTRODUCTION

While the approach of this study has been to compare similar plants with and without occupational nursing programs, it is also possible to assess the value of occupational nursing by studying plants which have recently hired a nurse and by identifying changes in costs and benefits which were associated with the introduction of the nurse. For example, a brick plant with approximately 200 employees was identified as having laid off a nurse and subsequently rehired the nurse after 2 years. A review of workers' compensation loss data for this plant suggests that the rehiring of the nurse was associated with an average annual reduction of 66 claims with a total average savings of $17,000. Adjusting for annual differences in the numbers of man-hours worked, this represents an average annual savings of $0.034 per man-hour worked. Obviously, it is difficult to generalize from the experience of a single plant, or even four pairs of plants; however, these data do seem to support the contention that occupational nursing can be an economic benefit to plant management. Information collected during this study from the four pairs of plants provides further support for this hypothesis.

It should be stressed at the outset that the focus of this study on occupational health nursing recognizes that the full-time registered nurse, more than any other health professional, is the predominant provider of health care in small plants. Some safety and health programs in small plants are staffed by other health professionals including visiting or part-time nurses and by allied health workers such as licensed practical nurses, physicians' assistants, or emergency medical technicians. It should also be noted that while the allocation of costs associated with an occupational nursing program is generally straightforward, the procedures for attributing the specific benefits of these discrete nursing services are subject to broad interpretation. Factors unrelated to nursing programs, such as management and labor relations, personnel attitudes, existing in-plant safety programs, attitudes of local health care providers, and insurance company loss control services can affect the quality of occupational safety and health programs.

COSTS TO THE EMPLOYER

The costs which are borne by an employer for an occupational safety and health program include:

- Costs of Physical Facilities: Ideally, these include the cost of space, based upon its best alternative value for productive purposes; the apportioned cost of utility services such as heat and lighting; and the cost of capital equipment and fixtures including costs for interest, maintenance, and depreciation. As a practical matter, however, some plants employ cost per square foot as an estimate of physical facility cost while others, especially where the potential cost is negligible, include these charges under miscellaneous overhead.
- Costs of Supplies: These include the costs of first aid supplies and materials for physical examinations, as well as journals and other printed matter that are charged on a regular basis. In some cases, these costs are charged to the personnel department, whereas in other instances costs may be "charged back" to production units. Specific data are usually not readily available for these expenses.

- Costs of Staff: In the case of a plant nurse, information on salary is readily available from the personnel department. Additional costs include the value of company paid fringe benefits as a percentage of the base salary. Other staff costs may include fees for physicians, consultants, and clerical assistants. In the case of first aiders, these persons are typically production or management employees who have basic medical training and serve in this capacity on a voluntary basis. However, there may be labor and material costs associated with their training and periodic recertifications.
- Other Costs: Depending upon the nature of the program and the accounting system, there may be additional costs such as general and administrative overhead, travel costs, and costs of employees' time when utilizing program services.

In the four case studies, the costs of the occupational health nursing programs ranged from $20,000 to $25,000, while the costs of the first aid programs ranged from $1,000 to $2,000. The net costs of the occupational health nursing programs were estimated by subtracting the estimated costs of essential first aid and associated administrative activities from the total cost. The resulting net costs ranged from $14,000 to $18,000.

COSTS TO THE EMPLOYEE

These costs are negligible and, in any case, are normally reimbursed by the employer. In theory they might include loss of wages, loss of personal time, and expenses associated with travel or materials such as bandages, medications, etc.

DIRECT BENEFITS TO THE EMPLOYER

Generally, direct benefits are reductions in costs which are quantifiable. Often, however, a benefit may be direct in theory, while in practice, sufficient information may not be available at the plant level, for quantification. This section addresses a range of direct benefits and draws upon the case studies for practical examples:

- Reduction in Occupational Injury and Illness Costs: Under the workers' compensation insurance system, the employer accepts a certain but limited liability for occupational injury and illness while the employee surrenders the right to sue for unlimited damages and accepts scheduled benefits including compensation for permanent disability, medical care and rehabilitation, and supplements for lost income. As a somewhat predictable cost of doing business, premium costs for the employer become a standard element in overhead costs which eventually are borne by the consumer. In recent years, however, the cost of workers' compensation insurance has increased dramatically, partly as a result of larger disability awards and also as a result of the escalation of medical care costs. Numerous research programs have been undertaken in response to the continuing rise in workers' compensation costs associated with occupational injury and illness. One recent study has demonstrated that a reduction in the value of compensation losses can result in an ultimate saving in premium costs that is 1.5 to 2.5 times the value of the initial loss reduction. This results because compensation premiums are based upon a moving average calculation and also reflect markups for overhead and profit.

The primary source of data on workers' compensation costs was insurance company reports; however, in conducting case studies, it was found that the responsible individuals in some plants were not knowledgeable regarding either their current loss experience, particularly the impact which losses have on the economic performance of the plant, or alternative strategies which are available to them for reducing these losses. Where insurance company data were not available, attempts were made to estimate benefits from sources such as OSHA Logs of Occupational Injury and Illness. The estimated savings in workers' compensation costs associated with having a plant nurse ranged from $15,000 to $24,000, based upon insurance company loss experience reports as the primary data source. Alternative estimates of savings, based upon differences in the numbers of cases recorded in the OSHA Log, ranged from $1,000 to $9,000. When employees require offsite treatment, wages are paid for the initial lost time from work. However, if the case incurs additional lost time, wages may not be paid unless the lost-time duration qualifies for workers' compensation. If the plant nurse treated these minor cases, which otherwise would require a single outside visit, it is estimated that the savings of lost wages would range from $300 to $1,000.

- Reduction in Costs for Physical Examinations: Most plants require that new or prospective employees receive physical examinations to assure that the employee is physically able to perform assigned tasks. Under some OSHA health standards, such medical examinations are mandatory and specific clinical tests are required for certain job categories. Frequently, the plant nurse will conduct these examinations, collecting medical and occupational histories and performing clinical tests and procedures. Ideally, the nurse will arrange for the physician to visit the plant on a regular basis to conduct portions of these examinations. In some plants, employees are required to have annual or periodic physical examinations, and there may be periodic medical monitoring based upon specific exposure conditions. A review of the case studies indicates that the contribution of the plant nurse toward completion of employee physical examinations could result in cost reductions of $1,400-$2,400, compared to an examination procedure conducted solely by a physician. It is anticipated that the value of the nurse will increase as OSHA regulations mandate more comprehensive health standards for physical examinations and medical monitoring. On the other hand, some plants have extremely low turnover or minimal exposures to toxic substances. In these situations, fewer physical examinations are necessary and the direct value of a nurse is less apparent.
- Reduction in Nonoccupational Medical Costs: The employer's share of nonoccupational medical costs results from contributions toward medical insurance premiums. A wide variety of programs exist including standard major medical insurance, administrative services contracts (self-insurance), and health maintenance organizations. Most insurance programs retain a $25 quarterly deductible so that minor injuries or illnesses become out-of-pocket costs for the employee. It is difficult to compare plant performance because experience ratings may be based upon community performance and because medical costs and utilization of medical services vary considerably by region. Nevertheless, it is clear that premiums for this type of insurance are considerable costs for the employer and that efforts to control these costs can result in substantial savings. The plant nurse may not have

a direct impact on claims made by employees' dependents, but there is a definite opportunity to control employee claims. In the case studies, the activities of the nurse in the area of health promotion and disease prevention are described and anecdotal information illustrates the scope of these related activities and their potential benefits.

INDIRECT BENEFITS TO THE EMPLOYER

Indirect benefits are considered to be those which are not directly attributable to a particular nursing activity but the effect of which can be evaluated in generally qualitative terms.

- Reduction in Absenteeism: The plant nurse may have an impact on absenteeism by insuring that employees are placed in positions which are medically appropriate, by improving the overall health status of the employee population, by improving employee morale, and by controlling malingering or nonmedically related absence. Although nursing may influence these indirect benefits, there is some question regarding the contribution of these factors toward the overall level of employee absenteeism. For example, improved health status of the work force would probably not reduce absenteeism that was not medically related and, moreover, it is difficult to establish the correlation between nursing, morale, sickness, and absenteeism. In the plants with nurses, personnel managers generally believed that the nurse helped to improve morale and health status and to control absenteeism. Although no direct causal link was demonstrated, this was an observation based upon experience and it often was a major justification for having a plant nurse.
- Reduction in Labor Turnover and Increased Worker Productivity: These benefits may be indirect results of occupational nursing activities; however, there are other factors which are probably more influential, such as wage scales and employee attitudes toward the job and supervisory personnel.

DIRECT BENEFITS TO THE EMPLOYEE

Although the employer bears most of the cost for occupational safety and health programs, the employee, as the patient or consumer, receives substantial direct benefits which are assumed to be indirect benefits to the employer. Direct financial benefits to employees may be viewed as an increase in real wages, and include:

- Reduction in Lost Wages: Provision of an in-plant occupational health nursing program can reduce the number of visits for outside medical care and, as a result, can reduce the amount of working time which employees lose while in transit. This does not usually apply for a single occupational visit because the employees could be compensated for lost time but it is relevant for nonoccupational cases. In the case studies, the consensus held that a visit for outside medical care would require approximately 2 hours. If these appointments occur outside of working hours, there is no loss of wages, but frequently services are only available during working hours and employees are faced with the decision to forego treatment or sacrifice wages. It was estimated, from data on the number of nonoccupational visits to plant nurses, assuming average hourly rates and average durations for medical visits that from

$46 to $4,300 in employee wages might be saved by having a plant nurse. The low end of the range is probably an underestimate because data were lacking on the frequency of this type of lost time.

- Reduction in Medical Care Costs: Associated with lost wages for nonoccupational visits are costs for medical care which could reach $100 per employee per year based upon a quarterly deductible of $25 for medical insurance coverage. In plants which have nurses, employees can receive minor nonoccupational nursing care and thus reduce their out-of-pocket costs for such care. In general, the nurse serves as a point of introduction to the medical system and, after providing preliminary care for nonoccupational conditions, will generally refer the employee to local physicians. For chronic conditions, the nurse can provide in-plant care under the direction of the employee's physician. The savings which a plant nurse might generate were estimated to range from $80 to $9,000. Again, the low end of this range is probably an underestimate due to a lack of data.

INDIRECT BENEFITS TO THE EMPLOYEE

An occupational health nursing program is associated with numerous indirect benefits to employees, which are difficult to distinguish from benefits associated with the related activities of management and labor. Even without consideration for financial savings, the plant nurse, through health education and counseling, may provide an indirect benefit by improving employee morale, improving their health status, and reducing anxieties related to potential illness or exposure to occupational hazards.

SUMMARY OF COSTS AND BENEFITS

In the preceding sections, specific items of direct and indirect costs and benefits have been discussed and those which are direct costs and benefits to the employer are summarized in Table 2. While it is not possible to derive a specific bottom-line savings or cost/benefit ratio, these data do demonstrate that occupational health nursing programs can provide substantial economic benefits which in some instances, such as the case study of processing machinery, may completely cover the costs of the program. The reader is referred to the individual case studies for a more detailed discussion of occupational health nursing programs and the related costs and benefits.

TABLE 2

SUMMARY OF COSTS AND BENEFITS TO THE EMPLOYER

Costs	Pair A Machinery	Pair B Electronics	Pair C Textiles	Pair D Clothing
Nursing Program Net Cost	$15,000	$15,000	$14,000	$18,000
Benefits				
Savings for Physical Examinations	$ 2,100	$ 1,500	$ 1,400	$ 2,400
Savings in Wages Paid for Outside Medical Visits	$ 1,000	$ 300	$ 700	$ 800
Savings Based on Workers' Compensation Data*	$15,000-24,000	$20,000	N.A.	N.A.
Savings Based on OSHA Log Data*	$ 6,000-9,000	$ 1,500-2,400	N.A.	$ 1,000-1,600
Savings Based on First Aid Log Data*	N.A.	N.A.	$ 1,700-8,000	$ 1,700-11,000

N.A.: Information not available.

*Estimated savings vary depending upon the source of data.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

It was not possible to structure a rigorous cost/benefit analysis based upon the available data from the case study facilities. However, a preliminary financial evaluation indicates that the cost of in-plant occupational health nursing is associated with substantial direct financial benefits to plant management. The overall benefit of a plant nurse is enhanced further by indirect benefits to the employer as well as direct and indirect benefits to employees. Areas where direct and indirect benefits were identified during this study include:

- Reductions in workers' compensation insurance premiums.
- Reductions in wages paid during lost time from work.
- Reductions in the costs for physical examinations.
- Reductions in nonoccupational medical costs and related insurance premiums.
- Increases in productivity related to reductions in absenteeism and labor turnover.
- Increases in real wages for employees.
- Reductions in employee medical care costs.
- Improved employee health status and morale.

Also, factors which affect the level of benefit associated with a plant nurse have been identified including:

- The size of the employee population.
- The frequency of preplacement and periodic physical examinations.
- The frequency of occupational cases of injury and illnesses which are sent to a doctor's office or hospital emergency room.
- The amount of lost time associated with nonoccupational injury and illness.
- The availability of cost-effective medical services in the community.
- The level of responsibility which the plant nurse assumes, either independently or through medical directives.
- The commitment of plant management to improve the health status of employees while controlling health care costs.

These results do not mean that all occupational nursing programs will pay for themselves, however, they do show that the costs of such programs can be substantially reduced. The potential for direct financial benefits as well as the more qualitative indirect benefits are sufficient to demand careful consideration by plant management.

RECOMMENDATIONS

For those who anticipate conducting similar studies, it is necessary to identify some of the practical considerations associated with undertaking this type of program. For example, during the initial phase of this program, difficulty was encountered in matching pairs of plants according

to the selection criteria. Matching by employment size was difficult because similar sized firms tend to have comparable policies regarding the hiring of an occupational nurse. Also, in some industries there were uniform patterns (irrespective of employment size) regarding the hiring of occupational nurses. In other sectors, hiring practices were related to size of employment, with some attention directed toward identifying a minimum number of workers to justify hiring a nurse. There was a general trend suggesting that a new, high technology industry was more inclined to retain the services of a nurse than a more mature industry. Even in plants which have occupational health nursing programs, the nature of the program varies from largely clerical services to the provision of more comprehensive preventive and primary nursing care. The nursing programs addressed in this study are typical of real-world small plants where many of the elements of "quality" programs are present, but only to a limited extent. In many cases the nurses were hindered by paperwork, had little training in occupational safety and health, and seemed to assume a passive and reactive rather than active and preventive approach to occupational health nursing. In order to maximize the benefits of an occupational health nursing program, plant nurses should be trained and experienced in occupational safety and health, motivated to work independently, and given sufficient freedom and support by management to develop the best possible occupational nursing program, which should include at least the following elements:

- Emergency care for ill and injured workers.
- Preventive health services to workers at their place of employment.
- Appropriate health assessment and health screening services.
- Counseling services.
- Health and safety education.
- Rehabilitation services.
- Systems for recording health and safety data.

A major problem area in this study was related to the lack of accurate and comprehensive data. Frequently, plant personnel were entirely unfamiliar with data related to their workers' compensation loss experience because these programs were administered at the corporate level. Concerning OSHA Logs, most plants used them to record all occupational cases which required outside treatment regardless of whether they qualified as "OSHA reportable" incidents or were only "first aid" cases. Similar problems were encountered with nonoccupational cases because insurance claims were processed by the employees themselves, and internal reviews of experience were not conducted.

The major recommendations which can be made as a result of this study are not directed toward future research programs, but rather, they focus on steps which plant managers should take when evaluating their individual plants regarding the feasibility of an occupational nursing program. These steps, which do not necessarily depend on having a plant nurse, include:

- Evaluate the current program of physical examinations in light of current and anticipated regulations, and in terms of their value in issues of workers' compensation liability.

- Establish an accurate system for recording all occupational injuries and illnesses, distinguishing between those which are treated by in-plant personnel and those which are treated outside the plant.
- Record the amount of time lost from work and any accounted medical costs for each occupational case which leaves the plant.
- Review the claims history as well as records of absenteeism to determine potential savings by providing in-plant services for nonoccupational cases.

A clear understanding of these factors will enable plant management to more accurately evaluate the nature of their costs associated with employee injury and illness and will provide a baseline for initiating efforts to control these costs.

CASE STUDY A
PROCESSING MACHINERY PLANTS

PLANT 1: WITH AN OCCUPATIONAL HEALTH NURSING PROGRAM

PLANT 2: WITHOUT AN OCCUPATIONAL HEALTH NURSING PROGRAM

PHYSICAL PLANT AND PRODUCTION PROCESSES

Plant 1 is about 20 years old. The plant has a single-story layout which covers a total of approximately 268,000 square feet. About 20 percent or 50,000 square feet is devoted to office space with the remaining 218,000 square feet for manufacturing. There is also a small demonstration facility and laboratory about 3 miles from the main plant. The plant manufactures processing machinery for the pulp and paper industry and the plastics industry. Typical products include pulp preparation equipment, fiber processing and de-inking systems, injection molding machinery, and container-forming systems. The manufacturing process is a job-shop custom operation rather than an assembly-line operation. The unit operations involved in the manufacturing of machinery include storage and handling of parts and sheet metal; pressing and stamping; drilling, milling, and lathing; shearing and sawing; fabrication and erection; paint spraying; and machine maintenance.

Plant 2 has 2 locations including the main facility which is less than 10 years old. This facility has a single floor layout which covers approximately 151,000 square feet. The machine shop is located about 2 miles from the main facility. This building incorporates several old warehouses which are of cinder block and wood frame construction covering approximately 96,000 square feet on a single-story layout. The plant manufactures large processing machinery for the plastics industry, primarily injection molding and extrusion machines. The unit operations are similar to those at Plant 1.

The manufacturing processes may be characterized in terms of their most significant hazards and the occupational illness or injury which may result from exposure to these hazards. The primary concerns are sprains and strains from handling heavy materials, foreign bodies in the eyes, and contusions and lacerations from handling metals and machine tools. The use of chlorinated solvents for metal degreasing and paint spraying are potential chronic hazards. Also there is a potential for dermatitis as a result of sensitivity to cutting oils, welders may be exposed to eye hazards and excessive noise may be present. A review of the OSHA Logs of Occupational Injury and Illness (Table 3) for the years 1976-1978 reveals the types of injury or illness which may result from these exposures.

It is noteworthy that, although eye injuries were a problem in the past at Plant 1, in 1978 no eye injuries were reported. This is probably due to the effective enforcement of an eye protection program. At Plant 2, eye injuries were a problem throughout the period from 1976 to 1978. Burns and dermatological problems were also frequently reported. At both plants, lacerations, back strains, and contusions and abrasions were major causes of injury.

TABLE 3

PAIR A – PLANTS 1 AND 2
REPORTED OCCUPATIONAL INJURY AND ILLNESS
1976-1978

Type of Injury or Illness	Number of Reported Cases 1976-1978*	
	Plant 1	Plant 2
Laceration/Other Cuts	53	107
Contusion/Abrasion	39	45
Back Strain	38	68
Foreign Body in Eyes	37	72
Sprain/Other Strain	30	44
Fractures	9	14
Eye-Flash Burn	6	3
Burn	2	12
Puncture	1	0
Chemical Irritation	1	0
Dermatitis	0	11
Infections	0	3
Electrical Shock	0	1
Lymphadenitis	0	1
Other Types	5	13

*The 1976 log may include some first aid cases as well as "OSHA reportable" injuries.

WORK FORCE CHARACTERISTICS

The number of employees by year is shown in Table 4. As noted, the number of employees at Plant 1 has increased over the past few years, to a total of 660 in 1979. The plant production employees are represented primarily by the United Electrical Radio and Machine Workers union. There was a work stoppage in the summer of 1978, during which the plant was shut down for 10 weeks, including the normal 2 week vacation shutdown period. Thus there were 8 weeks of unscheduled nonproduction during 1978, so that the plant was in operation for essentially 10/12 of a year. Thus, for 1978, the average number of man-years of work was approximately 83% of the expected total. For example, the number of man-years of exposure for production and maintenance employees would therefore be 318 x .83 = 265 equivalent number of employees per year.

Of the production employees, about 100 people work on the second and third shift. Thus the average number of employees on the day shift would be 247 currently. The production employees are virtually all male, while the clerical/professional employees consist of about equal numbers of males and females.

The population at Plant 2 was relatively stable until 1979 when it increased to a total of 565 employees due to the installation of additional product lines. The employees have recently unionized with the International Association of Machinists under a contract which became effective in early 1979. There have been no work stoppages during the past 3 years except for an annual 2 week plant shutdown in the summer.

TABLE 4

PAIR A – PLANTS 1 AND 2
EMPLOYEE POPULATIONS

	1978		1977		1976	
	Plant 1	Plant 2	Plant 1	Plant 2	Plant 1	Plant 2
Production and Maintenance	318	325	283	300	278	303
Clerical/Professional	294	165	290	164	285	166
Total	612	490	573	464	563	469

The majority of production occurs during the first shift; however, employees are encouraged to work 2 extra hours so that a 50-hour work week is common. There is a 38-man night shift at the machine shop facility. The production staff is entirely male with the remaining staff predominantly (70%) male. Most of the work force is caucasian. In general, the production employees and their families have been local residents for generations and their heritage is said to have provided them with a strong work ethic.

OCCUPATIONAL SAFETY AND HEALTH PROGRAMS

Management Attitudes Toward Occupational Safety and Health

At Plant 1, the nurse, as well as the personnel manager and the industrial relations representative, report to the director of industrial engineering. This variation of organizational relationships does not appear to affect the responsibilities or effectiveness of the plant nurse.

The personnel manager indicated that the division was committed to an occupational health nursing program for the following reasons:

- Someone was needed to provide first aid assistance in the plant, especially because serious accidents could occur and the hospital they utilize is five miles away.
- The plant nurse exercised cost control on both occupational as well as non-occupational cases of illness and injury. The nurse's recommendations or follow-up comments were listened to by the insurance company which handled the accident and sickness policies.
- The plant nurse provided counseling with regard to family and health matters, which was considered desirable by management.
- The nurse took care of the insurance paper work, including life insurance. The personnel manager estimated that otherwise she would require at least one quarter time clerk at $10,000 per year plus 20% fringe, so that the paper work that the plant nurse handled might cost an additional $3,000 per year otherwise.

The division has had a plant nurse for at least 20 years and this decision was made at the divisional, rather than the corporate level.

At Plant 2, the director of personnel is responsible for plant safety and health and he reports directly to the president. He is assisted by a personnel and benefits administrator. They do not have a set of formal policies with respect to health matters, although they are currently developing a set of work practice and safety rules. The plant does not have an occupational nurse because it is thought to be more economical to use the emergency room of the local hospital. (1 ½ miles from the plant) and a physician's office which is located in an office building adjacent to the hospital. There is also direct access to an ophthalmologist in the nearby town and to several physicians who maintain offices in their industrial park. The service from the physicians and the hospital was felt to be good. Furthermore, the director of personnel felt that the logistical problems of covering two facilities outweighed the benefits of having a nurse.

Program Facilities and Equipment

The health facility at Plant 1 occupies approximately 550 square feet and consists of a large L-shaped room with a small bathroom and a small examining room. The facility is equipped with routine first aid equipment, over-the-counter drugs, and basic supplies and equipment for conducting physical examinations. Hand resuscitators and portable oxygen are available. The plant does not have major medical equipment such as spirometers or X-ray machines. Estimated annual costs for facilities and equipment include about $2,000 for allocated space costs, $1,000 for supplies, and $100 for courses.

At Plant 2, a first aid room is located in the assembly area of the main facility. It is approximately 192 square feet in size and is equipped with basic supplies including a cot, washroom, and shower. The first aid room at the machine shop has been dismantled. Foremen have access to first aid kits in their offices. The personnel manager estimated that the plant spent about $1,000 per year for first aid related supplies and that the cost for space was about $960.

Program Description and Personnel

Plant 1 has a registered nurse who has been employed for 5 years. Prior to becoming an occupational nurse, she was with an urban general hospital. The nurse works a 5-day, 40-hour week and she estimated that her time might be allocated into 5 general categories as shown in Table 5.

TABLE 5

PAIR A – PLANT 1
ALLOCATION OF NURSING ACTIVITIES

Activity	Hours/Week	% of Time
First Aid for Minor Injuries	10	25
Blue Cross/Blue Shield	12	30
Workers' Compensation and Sickness and Accident Claim	12	30
Chronic Illness and Health Counseling	4	10
Safety Programs	2	5
Total	40	100%

The plant nurse does not have any formal training in occupational health. She is certified to instruct first aid and cardiopulmonary resuscitation and she plans to take an emergency medical technician course. The nurse received a salary of $13,500 plus fringe benefits valued at 20% or $2,700 for a total cost of $16,200. The plant also spent $750 for a substitute during the nurse's 10 days of vacation.

Additional plant personnel who contribute to occupational health include the industrial relations representative who is responsible for plant safety, 35 to 40 employees trained in first aid, of whom 12 to 15 are trained in cardiopulmonary resuscitation. Little assistance in occupational health is provided to the plant from outside sources, except for monthly visits from the safety inspector of the workers' compensation insurance agency. Three years ago the regional medical center conducted a tuberculosis screening program and they continue to monitor the positive reactors. The plant does cooperate with the local bloodmobile collection activities. A local surgeon visits the plant 1 day per week for about 1 hour to conduct preplacement physical examinations and provide occasional follow-up medical care for employees. The cost of this service is based upon an hourly rate of $60 for an estimated annual total of 50 hours or $3,000. The plant is currently self-insured for workers' compensation, although they have used several commercial carriers in the recent past.

Plant 2 utilizes clinics and the local hospital emergency room for most of their medical requirements. Physicians do not visit the plant to conduct preplacement physical examinations although some have taken a tour of the facility. A few employees are trained in first aid and cardiopulmonary resuscitation; however, they are not encouraged to become involved in treating injuries. Plant management prefers to send any questionable cases directly to a physician or the emergency room.

Health Promotion and Disease Prevention

At Plant 1 preplacement physical examinations are carried out by a surgeon who visits the plant for about 1 hour per week and provides consultation. The plant nurse takes the history, vital signs, urine specimen, and provides an eye examination. The examination by the surgeon takes only about 10 minutes. At a cost of $60 per hour, the physician cost for the examination is therefore about $10. If the same physical examination was carried out at his office, the cost would be $25. The savings, therefore, are about $15 per examination. There were 94, 81, and 121 such preplacement physical examinations during 1976, 1977, and 1978 respectively. Thus during 1978 the availability of the plant nurse saved 121 x $15 = $1,815 in physician time for preplacement physical examinations. A number of annual physical examinations are carried out on people who use moving machinery. These account for 30-40 examinations per year and are similar in nature to the preplacement examinations. Therefore, there is an additional savings of 40 x $15 = $600 for the annual physical examinations. The plant nurse is responsible for safety equipment and training and provides first aid courses several times a year as well as coordinating cardiopulmonary resuscitation courses. The nurse monitors programs for hypertensives and weight watchers and administers influenza, tetanus and smallpox innoculations.

The nurse described several instances where she felt her presence in the plant resulted in dramatic benefits. For example, an employee was having vision problems, and could not be seen by an ophthalmologist for three weeks. Recognizing that the employee was a diabetic, the plant nurse called the ophthalmologist and insisted that he be seen immediately. It is quite possible that the employee's vision might have been permanently impaired if he had not been given

immediate medical attention. Another employee complained that he had been having a headache for about three days, and did not have a personal physician whom he could visit. Suspecting hypertension, the plant nurse determined that the blood pressure was dangerously elevated and arranged for an immediate appointment with the physician, thereby possibly avoiding a stroke. In another similar situation a potential cardiac arrest may have been averted through prompt detection and treatment. These examples illustrate another important function of the plant nurse. She is often the point of entry to the medical provider system for those employees who do not have a personal physician or who are reluctant to utilize such provider services.

At Plant 2, during 1978, there were 133 preplacement physical examinations for new employees under the age of 40, and 10 for new employees over the age of 40. The cost for an under-40 examination, which included complete blood counts, chest X-ray, urinalysis, vital signs, hearing examination and physician's examination, was $75, including $30 for the physician. The cost for the over-40 employees was $100 per exam and included a blood chemistry profile, electrocardiogram and a more thorough examination. The total cost for preplacement examinations was estimated at $11,000, including $4,400 for the physician (note that the cost for the physician component could have been considerably reduced if there had been a plant nurse who could have completed certain portions of the examination). The only other activities of a preventative nature are quarterly safety surveys by the loss control representative of the workers' compensation insurance carrier.

Occupational Injury and Illness

Table 6 summarizes the occupational injury and illness experience of Plant 1, as developed from a review of the OSHA Logs of Occupational Injury and Illness for the years 1976-1978. This summary includes "First Aid" visits which were seen by a doctor but which were not considered to be reportable by OSHA definitions. These incidents did incur workers' compensation costs because of the physician's fees. The table shows that although the total incidence rate has been relatively stable for the past 3 years, at an average of 20 injuries per 100 employees, 39 per 100 production employees, the lost-time case rate and the duration of lost time and restricted activity appears to have decreased substantially. The average lost time case rate was 5.9 per 100 employees or 11.5 per 100 production employees with an average of 13.5 days lost per case or 13.1 days lost per production worker case.

It was estimated that approximately 60% of the 5,000 visits seen by the nurse each year were occupationally-related injuries. Many cases were handled by the nurse, with the remainder being sent to the emergency room, the employee's private physician, or to an ophthalmologist in the case of an eye injury. It was felt that having the nurse considerably reduced the number of emergency room visits. For example, approximately 75% of the eye injuries (which run about 15 per month) were handled by the nurse, and only 25% needed to be seen by a physician. The nurse estimated that the number of visits to the emergency room during the second and third shifts was probably 15% higher than on the first shift, when she was available, despite the fact that there was a foreman with good first aid training available on the second shift. When an employee must be sent to the emergency room, he may drive himself, be taken in a cab, or by the voluntary ambulance, or by the plant nurse. The average time lost is about 2 hours per employee. The emergency room charges, including physician and ancillary costs for a first aid incident, typically are between $45 and $50.

TABLE 6

PAIR A – PLANT 1
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees**)

	Personnel		Total	First Aid	Reportable Cases	Cases With Days Absent	Days Away From Work	Days of Restricted Activity	Average Days/ Lost-Time Case
1978	Hourly	318	37.1	21.1	15.9	9.1	72.7	2.5	8
	Salary	294	1.6	1.2	.4	.4	.8	0	2
	Total	612	20.0	11.6	8.5	4.9	38.2	1.3	7.8
1977	Hourly	283	37.8	16.6	21.2	12.0	173.5	11.3	14.4
	Salary	290	.3	0	.3	.3	20.7	1.0	6.0
	Total	573	18.8	8.2	10.6	6.1	96.1	6.1	15.7
1976	Hourly	278	42.1	*	*	13.3	223	.7	16.8
	Salary	285	.7	*	*	.4	7.7	0	22
	Total	563	21.1	*	*	6.7	114	.4	16.9
Average 1976-1978									
	Hourly	293	39.0	*	*	11.5	89.7	4.8	13.1
	Salary	290	6.7	*	*	.4	9.7	.3	28
	Total	583	20.0	*	*	5.9	82.8	2.6	13.5

*Information not available.
**Adjusted for plant shutdown.

Table 7 summarizes the occupational injury and illness experience of Plant 2. The table shows a gradual trend of decreasing incidence rates from 1976 to 1978, with an average total rate for the period of 40.9 incidents per 100 employees or 62.3 per 100 production employees. The average lost-time case rate was 11.7 per 100 employees or 17.9 per 100 production employees with an average of 9.2 days lost per case and also 9.2 days lost per production worker case.

An analysis of the accident experience at Plant 2 was conducted by the workers' compensation insurance Carrier. Table 8 summarizes the data including cases with compensation for lost wages and cases which only incurred medical costs. Losses include actual payments plus estimated reserves at the time of evaluation (2/1/79). According to this review the plant had 44 compensable cases and 118 cases which required medical attention but which did not require indemnification for lost wages. The workers' compensation premiums are calculated on a retrospective basis and currently average $66,000 per year. The plant utilizes services of an occupational nurse from their workers' compensation insurance carrier to evaluate employees prior to their return to work after long-term illnesses or injuries.

The plant nurse has kept a record of the numbers and types of visits made. Table 9 presents a summary of this data. Approximately 2,913 visits per year are associated with occupational problems. The nurse estimated that approximately 10% - 15% of these cases would have required a visit to a physician if she had not been present. The emergency room that is utilized by the plant is about 5 miles away, or 15 minutes by car and the service is reported to be satisfactory. In addition, there are ophthalmologists and other specialists in the area who are utilized when appropriate. The majority of occupationally related injuries are hand lacerations and back injuries. The nurse consults with the employee's physician on long-term cases for which such follow-up is appropriate.

Nonoccupational Injury and Illness

Employees at Plant 1 are encouraged to utilize the services of the nurse for nonoccupational health problems, in order to reduce absenteeism. On an annual basis, 1800 or 40% of the visits to the nurse are in the nonoccupational category. These include a variety of minor cuts and colds, as well as follow-up on more serious health problems. The nurse encourages nonoccupational visits and feels that a considerable amount of lost time is avoided by caring for employees at the plant. For example, Monday was noted as "splinter-day" when weekend, nonoccupational injuries were treated. The plant nurse reviewed a recent 1 week sample of nonoccupational visits, in terms of whether they were made by production or office employees. Thirty-five percent of such visits were made by production versus 65% for office employees, compared to an employee ratio of 52.5% production and 47.5% office employees. Thus, whereas the occupational visits are essentially all made by production/maintenance employees, office employees make almost twice the number of nonoccupational visits (4.2 per employee per year) compared to production/maintenance employees (2.25 per employee per year). The plant nurse estimated that, if she were unavailable, 10% of these cases would go to a physician with additional cost to the employee and the employer. The average cost for a physician visit in the area is $15-$10 (excluding special treatment and medicines). The plant nurse also provides care for chronic conditions to a number of employees, for example, those with hypertension, allergies, and diabetics. This would involve about 15 employees who make some 20-25 such visits per week for health maintenance.

The plant provides a Blue Cross Master Medical Plan for employees, wholly paid for by the company under an administrative services only contract with Blue Cross. The nurse handles a considerable amount of paperwork associated with nonoccupational health including medical insurance claims, sickness and accident claims, and life insurance.

TABLE 7

PAIR A – PLANT 2
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

	Personnel		Total	First Aid	Reportable Cases	Cases With Days Absent	Days Away From Work	Days of Restricted Activity	Average Days/ Lost-Time Case
1978	Hourly	325	55.1	13.8	41.2	17.8	208	28.9	11.7
	Salary	165	1.2	0	1.2	0	0	0	0
	Total	490	36.9	9.2	27.8	11.8	138	19.2	11.7
1977	Hourly	300	61.3	18.7	42.7	17	154	43	9.1
	Salary	164	.6	.6	0	0	0	0	0
	Total	464	39.9	12.3	27.6	17	100	27.8	9.1
1976	Hourly	303	71.0	25.4	45.5	18.8	126	15.5	6.7
	Salary	166	.6	.6	0	0	0	0	0
	Total	469	45.5	16.6	29.4	12.2	81.4	10.0	6.7
Average 1976-1978									
	Hourly	309	62.3	19.1	43.1	17.9	164	29.1	9.2
	Salary	165	.8	.4	.4	0	0	0	0
	Total	474	40.9	12.7	28.3	11.7	107	19.0	9.2

TABLE 8

PAIR A – PLANT 2
ACCIDENT ANALYSIS (1978)

Event	No. of Compensable* Accidents	% of Total	$ Losses	% of Total
Manual Lifting	8	18	$23,661**	47
Material Handling	4	9	1,569	3
Push/Pull	3	7	2,476	5
Fall/Trip	4	9	1,167	2
Fall/Slip	5	11	1,434	3
Struck By	5	11	4,707	9
Struck Against	5	11	1,551	3
Cut (Point of Operation)	2	4	4,438	9
Clearing Machine	1	2	225	1
Nip Point	1	2	328	1
Reaching	1	2	222	1
Occupational Disease	1	2	216	1
Burn	1	2		
Miscellaneous	3	7	1,517	3
Sub Total	44	100%	$45,232	100%
Cases with only Medical Expenses	118		5,406	
Total Cases	162		$50,638 (valued 2/1/79)	

*"Compensable" accidents include compensation or indemnity for lost wages.
**Includes one case valued at $19,500.

Source: Review by Workers' Compensation Insurance Carrier.

TABLE 9

PAIR A – PLANT 1
RECORDED VISITS TO THE NURSE

	Total	Nonoccupational	Occupational	Visits/ Day**	Visits/ Production Employee
1978 (FY)	4,695*	1,252*	3,443*	24	18***
1977	4,687	2,013	2,674	20	17
1976	4,763	2,140	2,623	20	17
Average	4,715	1,802	2,913	21	17

*Includes 10-week shutdown.
**Assuming 240 days in 1976 and 1977; 200 days in 1978.
***Adjusted for 10-week shutdown.

Plant 2 does not provide any services related to nonoccupational injury and illness except to supply an occasional aspirin or band-aid. A standard Master Medical Blue Cross program is available. Formerly the plant was on an Administrative Services contract but recently an insured plan has been instituted.

DISCUSSION

During the period from 1976 to 1978, Plant 1 reported 37 cases of eye injury. Apparently this type of injury had been a problem for many years and finally, in 1978, they implemented a strict safety eyeglass program. In that year there were no reports of eye injury. Assuming no change in the quality of reporting, this is a dramatic example of the benefit of a preventive measure. The nurse, in cooperation with other plant staff, should make a concerted effort to maintain the effectiveness of this program as well as to develop additional programs to improve plant conditions and protect employees from occupational hazards. For example, during interviews with the plant nurse, the issue of audiometric testing was raised. Apparently, the nurse had tried to develop a program but plant management preferred to wait for forthcoming Federal requirements. Further consideration should be given to this issue, including accurate characterization of the plant in terms of noise exposure and preplacement baseline testing, especially if the levels are close to the legal limit.

It appears that a major restraint for implementing a nursing program at Plant 2 is the perception that logistical problems outweigh potential benefits. Unfortunately, this attitude is common and in most cases it is based upon impressions rather than experience. There does not seem to be any logical reason why a plant nurse could not be mobile and in communication with more than one site. In fact, a part-time nursing service could be developed through cooperative arrangements for a group of separate small plants who might not be able to support a full-time plant nurse.

COMPARISON OF COSTS AND BENEFITS

PROGRAM COSTS

The direct cost of the nursing program in Plant 1 is about $20,000 per year, which is equivalent to $30 per employee or $60 per production employee. A portion of these costs would have been incurred even if there were no nursing program: namely, the cost of a first aid program, and the time for preparing reports for agencies such as OSHA or for insurance claims (Table 10).

TABLE 10

PAIR A – PLANT 1
NURSING PROGRAM COSTS (1978)

Item	Cost
R.N. Salary	$13,500
Fringes @ 20%	2,700
Vacation Fill-in 10 days	750
Supplies	1,000
Space (325 sq. ft. @ $6)	1,950
Courses	100
Total	$20,000

PAIR A – PLANT 2
FIRST AID PROGRAM COSTS (1978)

Item	Cost
Space (102 sq. ft. @ $5)	$ 960
Supplies	1,000
Total	$1,960

PAIR A – PLANT 1
NURSING PROGRAM NET COSTS (1978)

Item	Cost
Direct Cost	$20,000
Less: First Aid Offset	2,000
Less: Reporting Offset	3,500
Net Cost	$14,500

Cost of First Aid

The first aid program at Plant 2 was estimated to cost $2,000 per year, which is equivalent to $5.21 per production employee. If the same cost rate were to apply to Plant 1, the first aid program would have cost $5.21 x 347 production employees = $1,808. This estimate may be considered to be an offset against the actual cost of the nursing program.

Cost of Reporting Activities

The cost of the time associated with reporting activities can be estimated in several ways:

- About 25% of the plant nurse's time is associated with administrative activities, which presumably would have to be performed by someone else if there were no plant nurse. The cost of this time is estimated to be 25% x $16,200 (nurse's salary plus 20% fringe benefits) = $4,050.
- If we assume that a lower-salaried person could perform these functions and that it would require 25% of that person's time, then the cost would be 25% x $10,000 x 120% = $3,000, assuming an annual salary of $10,000 and fringe benefits of 20%.

Net Program Costs

The net cost of the occupational nursing program is therefore estimated to be the direct costs ($20,000) less the offsetting costs of first aid ($2,000) and reporting ($3,500) for a net cost of $14,500. This is equivalent to about $22 per employee or $42 per production employee on an annual basis.

PROGRAM BENEFITS TO THE EMPLOYER

Direct Benefits to the Employer

The direct benefits to the employer which accrue from having an occupational nursing program are quantitative financial benefits. Three distinct areas of benefit have been identified.

Physical Examination Costs

In Plant 1 the nurse does much of the preliminary paperwork, physical measurement, and testing required for preplacement physical examinations. This service is also provided for annual physical examinations of motor vehicle operators. Discussions with the plant nurse and the physician's nurse revealed that the differential between the physician's charge for a physical examination in his office and one at the plant is $15, which is assumed to be a savings due to the assistance of the plant nurse. Over the past three years, the plant nurse assisted on 139 physical examinations on an average annual basis (99 preplacement and 40 annual physical examinations). Each examination represents a savings of $15 in comparison to a similar plant which does not have a nurse, for a total annual savings of 139 examinations x $15 = $2,085.

Insurance Costs

- Workers' Compensation Loss Experience — a review of the loss experience reports for Plant 1 and Plant 2 was conducted and it was found that the annual dollar value of losses was 60% less in Plant 1 (with nursing) than in Plant 2 (without

nursing). This represents a direct benefit or savings of approximately $10,000. In addition, the savings is increased to an estimated range $15,000 to $24,000 because of the long-term impact of loss experience on the calculation of worker compensation premiums. It appears that not only is the total dollar loss experience reduced in the plant with a nurse, but also, it appears that the rate of workers' compensation cases per 100 production employees is reduced. If these cases are separated into cases with only medical expenses and cases with medical and indemnity (compensation) expenses, the plant with a nurse has a greater impact on decreasing the rate of cases with only medical costs (23 per 100 employees for Plant 1 vs. 46 per 100 employees, for Plant 2) than the rate for cases with medical and indemnity costs (9 per 100 employees for Plant 1 vs. 12 per 100 employees for Plant 2). On the other hand, if one attempts to describe the benefit of the nurse in terms of actual dollars of cost, the greater impact, both in actual value and as a percentage, is on the cost of cases with medical and indemnity charges as opposed to the cases with only medical costs. In either case, the occupational nursing program is providing a substantial savings in the cost of workers' compensation.

It should be noted that these data are not strictly comparable. The Plant 1 data is for 1978 while the Plant 2 data is for 1977. On the other hand, the dates of claim evaluation have a similar discrepancy and so should control for any time trends in claim payment. For example, the Plant 1 data from 1978 is valued as of March 1979 while the Plant 2 data from 1977 is valued as of February 1978. The only other available data which might be used for comparative purposes are estimates of reserves for claims made in 1978. On the basis of accumulated reserves Plant 1 had an annual total of about $25,000 while Plant 2 had about $51,000. This clearly confirms the earlier suggestion. Also, one might expect the Plant 1 data on claims paid for 1978 to be higher because of inflation than Plant 2 claims paid in 1977. It is unfortunate that more comparable data was not available for these plants.

- Comparison of OSHA Log Reports — At both Plant 1 and Plant 2 OSHA Logs of Occupational Injury and Illness for the years 1976-1978 were reviewed. The comparison of the two plants provides additional data for assessing the benefit of the occupational nursing program. Unfortunately, this data is not entirely reliable due to a certain amount of subjectivity in deciding whether or not a particular incident is "OSHA-reportable." In both Plant 1 and Plant 2, there was a tendency to record all cases which were seen by a physician or sent to an emergency room. In many instances those cases which were recorded but which were not deemed to be "reportable" were marked as "first aid" or were crossed out. Since the OSHA Logs apparently represent most of the "doctor cases," (either as "first aid or reportable" cases) they also represent a substantial proportion of the cases which incurred costs that are compensable under workers' compensation insurance.

  As noted in Table 11, the reported case rate for Plant 2 averaged about 62 per 100 production employees during 1976-1978, compared with 39 per 100 production employees for Plant 1, where a case is defined as any occupational injury or illness case sent to an emergency room or physician. The OSHA-reportable incident rate is also considerably higher for Plant 2 compared with Plant 1, but it is not clear whether this is a real effect (due to having a nurse at Plant 1) or whether this is a difference in definition of "reportable." The difference in case rates is, therefore,

TABLE 11

COMPARISON OF PAIR A – PLANTS 1 AND 2*

	Plant 1			Plant 2			Difference		
	Total	First Aid	Reportable	Total	First Aid	Reportable	Total	First Aid	Reportable
(FY) 1978	37.1	21.2	15.9	55.0	13.8	41.2	17.9	(7.4)	25.3
1977	37.8	16.6	21.2	61.4	18.7	42.7	23.6	2.1	21.5
1976	42.1	19.8	22.3	70.9	25.4	45.5	28.8	28.8	23.2
Average	39.0	19.2	19.8	62.2	19.1	43.1	23.3	(0.1)	23.3

*For cases sent to ER or M.D.; expressed as number of cases per 100 production employees.

62-39.0 = 23 per 100 employees. Thus, for Plant 1, which has 318 hourly employees, it is inferred that the occupational nursing program has contributed to a reduction of about 74 incidents per year. At an average cost of $50 per incident (assuming the reduction is in the more minor medical cases), the annual savings due to such a reduction is $3,700 in direct medical (workers compensation reimbursed) costs. As previously mentioned, a compensation case has a long-term impact which may range from 1.5 to 2.4 times the actual cost. In is case, the resulting savings for Plant 1 may range from $5,600 to $8,900. If this difference included reductions in compensable lost-time, the savings would be greater.

- Nonoccupational Medical Costs — Both Plant 1 and Plant 2 pay for 100% of their employee's Blue Cross/Blue Shield Programs; however, Plant 1 is self-insured under an Administrative Services contract while Plant 2 is insured with Blue Cross/Blue Shield. Unfortunately, even if the plant nurse was having a significant impact on Blue Cross/Blue Shield costs, such an impact would be diluted by the major cost impact of health care for dependents of employees.

Lost Production Time

The 74 occupational cases which may have been prevented by occupational nursing activities result in a considerable amount of time away from work for the employee. If one assumes a duration of 2 hours for a visit to a physician or the emergency room, this results in 148 hours of lost time and, at a base hourly rate of $7.00, this represents a loss of about $1,000. Since the employee is paid for this time away from work, it is the employer's loss for wages paid without productive work. For nonoccupational problems, the employee himself loses wages for lost time.

Indirect Benefits to the Employer

Indirect benefits are difficult to quantify, but, nevertheless, are generally acknowledged as being significant economic factors. They include the value of production which is lost due to illness or injury and effects on morale and employee relations which can directly affect productivity or indirectly affect the quality of the product.

Value of Lost Production

The economic impact of lost production time due to employee absence is most likely to result in increased costs due to overtime labor requirements. Such impacts may vary depending upon the nature of the industry, business cycles, single vs. multi-shift operations, or other factors.

Morale and Employee Relations

Occupational nursing services may be an important factor in maintaining a high level of employee morale and good relations between labor and management. However, data are not available to make a quantitative assessment of this benefit.

PROGRAM BENEFITS TO THE EMPLOYEE

Direct Benefits to Employees

An occupational nursing program can provide a direct economic benefit to employees by reducing the amount of wages lost due to out-of-plant medical appointments and savings on expenses for nonoccupational ambulatory care.

Lost Employee Wages

It is difficult to estimate the impact of lost production time due to nonoccupational illness or injury because of the difficulty in collecting data on nonoccupational cases in plants without nurses and in predicting the percentage of nonoccupational cases in plants with nurses that would have gone to a doctor if the nurse had not been present. It appears that many nonoccupational cases which are treated by the nurse are minor in nature and, if the nurse was not present, they would be self-treated or ignored. It is estimated, based upon a review of data in first aid logs, that the number of averted nonoccupational doctor visits falls between the range of 10% to 1% of the nurse's nonoccupational case load. For Plant 1 this range represents annually between 20 and 200 nonoccupational cases. If these cases involve 2 hours away from work at a base wage of $7 per hour, the total loss of employee wages may range from $280 to $2800. Although this wage loss may not be a direct loss to the employer, it may have an indirect impact on employee morale.

Savings on Nonoccupational Ambulatory Care

The averted nonoccupational cases, which may range in number from 20 to 200 cases, also result in medical care expenses for the employee. If the average case costs $20, this represents an annual loss from $400 to $4,000. For an individual, some of this cost may be absorbed by Blue Cross/Blue Shield, if quarterly expenses exceed the deductible.

Indirect Benefits to the Employees

Personal Health

The occupational nursing program at Plant 1 appears to have a positive impact on the personal health of employees. Anecdotes related to the detection of severe hypertension and subsequent efforts to arrange appropriate medical treatment are examples of one area where there is certainly a benefit to employees. Although it is assumed that such efforts are also indirectly beneficial to the employer, there is insufficient information to quantify these benefits. A potential area of impact is the calcualtion of medical insurance premiums or in the case of Plant 1 which is self-insured, direct savings resulting from the prevention of acute or chronic conditions.

Employee Job Satisfaction

It may not be reasonable to expect that nursing per se is such a significant benefit that it will negate other labor demands. On the other hand, it can be a positive influence for improving employee job satisfaction which is an integral part of good labor-management relations.

DISCUSSION

The Plant 1 nursing program is estimated to have an annual net cost of $14,500. Associated with this cost are both direct and indirect benefits which accrue to both the employer and the employees. The values of some direct benefits have been estimated:

- Savings on preplacement physical examinations. $2,000
- Workers' compensation savings estimated from loss experience reports. $15,000-24,000
- Workers' compensation savings estimated from OSHA Logs. $6,000-$9,000

- Savings on wages paid without production. $1,000
- Saved wages for employees. $280-2,800
- Savings on employee medical costs. $400-4,000

Note that these benefits are not all additive. Also, a number of indirect benefits have been identified and, although information is not available to make quantitative estimates, they should be considered in the assessment of benefits. Overall, it appears that the occupational health nursing program is providing a substantial economic benefit primarily from savings in workers' compensation costs. As a worst case, the net cost of the program ($14,500) is offset by employee benefits related to physical examinations ($2,000) and workers' compensation ($6,000) which leaves $5,500 to be attributed to indirect benefits or charged as cost. If the estimate of workers' compensation savings is taken as the average of the high and low estimates ($15,000) then the nursing program shows a profit of $2,500.

CASE STUDY B
ELECTRONICS PLANTS

PLANT 1: WITH AN OCCUPATIONAL HEALTH NURSING PROGRAM

PLANT 2: WITHOUT AN OCCUPATIONAL HEALTH NURSING PROGRAM

PHYSICAL PLANT AND PRODUCTION PROCESSES

Plant 1 includes 2 attached buildings and an outbuilding which cover a total of approximately 160,000 square feet. The layout is primarily single story with 2 small basement areas for electronics testing. The buildings are of modern brick construction ranging in age from 5 to 25 years. The major product of the plant is copper electron tubes for radar equipment. The manufacturing process is largely a manual operation consisting of printing and etching integrated circuits, assembly of circuit boards, and assembly of the product. Ancillary operations include electronic testing and a small machine shop operation.

Plant 2 includes 3 buildings with a total area of 120,000 square feet. All of the buildings are built of cinder block and brick. The plant manufactures electromechanical products and precision components used for the interconnection of circuits. The basic unit operations of the manufacturing process include plating of circuit boards, drilling and milling of boards and components, and hand assembly including soldering of the final product.

The manufacturing processes may be characterized in terms of their most significant hazards and the occupational illness or injury which may result from exposure to those hazards. The primary hazards and potential consequences involve sprains, strains, and lacerations from working with metals and handling heavy materials, burns and dermatitis from exposure to chemicals, and electrical shock from exposure to high voltage sources. A limited number of employees at Plant 1 work with toxic substances such as beryllium, cobalt, and tritium. A review of the OSHA Log of Occupational Injury and Illness for the years 1976-1978 shows the variety of cases that were reported (Table 12). The major categories of occupational injury at Plant 1 were lacerations and back strain. A considerable number of cases of chemical dermatitis have also been recorded. Among the category of other cases were 3 acute cases of sulfur dioxide inhalation.

The major category of occupational injury at Plant 2 was lacerations and other types of cuts. Additional significant types of injury were sprains and strains and contusions and abrasions. Although usually not recorded by the plant as occupational illness, a number of cases of rash or dermatitis were reported. Also one undiagnosed case of dizziness was reported.

WORK FORCE CHARACTERISTICS

The number of employees by year is shown in Table 13. The level of employment at Plant 1 has remained relatively constant over the past three years. The work force is predominantly caucasian, with only 11 persons classified as minority workers. Of the total work force, about 36% are female while among the hourly workers (excluding machinists) about 70% are female. The plant

TABLE 12

PAIR B – PLANTS 1 AND 2
REPORTED OCCUPATIONAL INJURY AND ILLNESS
1976-1978

Type of Injury or Illness	Number of Reported Cases 1976-1978	
	Plant 1	Plant 2
Lacerations/Other Cuts	18	51
Back Strain	25	14
Dermatitis	13	4
Contusion/Abrasion	9	21
Sprain/Other Strain	8	28
Foreign Body in Eyes	6	14
Burns, Chemical and Unspecified	5	6
Electrical Shock/Burns	5	0
Fracture	0	8
Infections	0	4
Other Types	6	7

TABLE 13

PAIR B – PLANTS 1 AND 2
EMPLOYEE POPULATIONS

	1978		1977		1976	
	Plant 1	Plant 2	Plant 1	Plant 2	Plant 1	Plant 2
Hourly	252	367	239	292	242	177
Machinists	56	N.A.	48	N.A.	41	N.A.
Chemical Platers	14	N.A.	13	N.A.	13	N.A.
Clerical/Professional	223	167	231	151	239	118
Total	545	534	531	443	535	295

N.A.: not applicable.

is not unionized and there have been no recent strikes, layoffs, or major shutdowns except for regularly scheduled vacations during the last week in December and for 2 weeks in the summer. The work is conducted primarily (95%) on the day shift with only 20 people on the second shift and about 5 on the night shift.

The employment size at Plant 2 has been growing rapidly over the past few years and in 1979 the population of hourly employees was approximately 450. The plant is not unionized and there have been no work stoppages in recent years except for regularly scheduled vacations. The plant runs two 8-hour shifts with about 150 employees on the second shift. At the time of the survey there was a considerable amount of overtime work due to a large backlog of orders. The expanding work force size is expected to reduce this problem. About 60% of the hourly work force is female and about 30% of the hourly work force is of Portuguese extraction. Most of the employees are young with almost 40% under the age of 25. The female employees tend to be older than the male employees.

OCCUPATIONAL SAFETY AND HEALTH PROGRAMS

Management Attitudes Toward Occupational Safety and Health

At Plant 1 the plant nurse reports directly to the personnel director who indicated that corporate policy required that all plants with more than 500 total employees must have a nurse. Corporate policies have also been developed for plant safety and the management of various occupational hazards. Informal corporate policy encourages employees to visit the plant nurse for nonoccupational health problems (as well as for occupational health problems) and also for health counseling.

According to the personnel director, the primary reasons for having an occupational health nursing program include:

- Providing a service to employees which is beneficial for employee-management relations.
- Providing health counseling; the personnel director believes that this is an important service and, if the nurse was not present, he would provide the service by hiring a specialist in counseling.
- Conducting various routine tests such as urinalysis and coordinating the radiation dosimeter program. The nurse also serves as an educational resource for training first aid and cardiopulmonary resuscitation teams.

The personnel director was unsure about the costs and benefits of an occupational nursing program. He did not think the costs could be justified strictly on the basis of handling first aid cases; however, he felt the costs were justified if one considered the overall impact of the nurse's activities.

At Plant 2 the corporate personnel director was responsible for occupational safety and health; however, these duties have been assumed by a recently hired plant personnel manager. The supervisor of the maintenance department is a trained emergency medical technician and is responsible for plant first aid programs. The plant is currently advertising for an occupational health nurse to provide services to the plant as well as to manage occupational safety and health

for the corporation. Apparently, the corporate personnel director believes that an occupational health nurse will be an asset to the corporation. This perception contradicts a recent study done by their workers' compensation carrier which determined, on the basis of the plant compensation costs, that a nurse was not justified. The corporate personnel director recognizes that workers' compensation is only one of several categories where the nurse can be beneficial to the corporation. He added that he would try to limit the amount of nursing time spent on administrative or clerical duties and to emphasize those activities directly related to occupational safety and health.

In the past the rationale for not hiring a nurse was that (1) people would "goldbrick" by needlessly visiting the nurse, (2) the company was considered to be light industry and, as such, without occupational safety and health problems, and (3) the initial expense of a nursing program would escalate, because the nurse would try to establish an "empire." The current corporate personnel director does not support these views and, in fact, has provided for a nursing program in the projected budget. He believes that the nurse will (1) improve the general health and morale of employees, (2) reduce absenteeism, and (3) reduce insurance claims. He cited an example of an employee who incurred 316 days of lost time for what was apparently a sprained ankle. He hopes that the nurse will be able to monitor lost-time cases to promote the speedy return of the employee to work.

Program Facilities and Equipment

The health facility at Plant 1 occupies approximately 400 square feet and consists of an office and waiting room, an examination room, and a room with a bed and storage cabinets. The facility is equipped with routine first aid equipment, over-the-counter drugs, physician-ordered medications, and basic supplies and equipment including a small sterilizer and portable resuscitators. The plant does not have major medical equipment such as spirometers or X-ray machines. The estimated annual costs for the program include $1,000 for supplies and $2,400 for allocated space.

Plant 2 has two first aid rooms, each covering about 80 square feet. They are each equipped with limited first aid supplies, a sink, and a bed. The annual cost for first aid supplies was $750, allocated space costs were $960, and training courses and materials cost $200 for a total cost of about $1,900. An additional fee of $550 was paid to a consulting physician.

Program Description and Personnel

Plant 1 has had a registered nurse for a number of years. The current nurse has been at the plant for 2 years. Previously, she worked in the neurosurgical unit of a local hospital. The nurse works a 5-day, 40-hour week and she estimated that her time might be allocated into five general categories as shown in Table 14. She took the job as plant nurse because she liked the schedule and also because she was interested in developing health education programs. She indicated that her experience in health education was an important factor in getting the job. She does not have any formal training in occupational health. She has taken a variety of counseling courses and is certified to teach first aid and cardiopulmonary resuscitation. The nurse received an annual salary of $13,000 plus fringe benefits valued at 38% of the base salary, or $4,940, for a total cost of $17,940.

The plant has an arrangement with a local physician to provide physical examinations and treatment on a fee-for-service basis. He provides these services at his office and does not visit the

TABLE 14

PAIR B – PLANT 1
ALLOCATION OF NURSING ACTIVITIES

Activity	Hours/Week	% of Time
Insurance and Personnel Details/ Paper Work	11	27.5
First Aid/Nursing Care	11	27.5
Counseling	10	25
Checking on Absent Employees	5	12.5
Teaching Courses	3	7.5
Total	40	100%

plant on a regular basis. Additional plant personnel who contribute to occupational health include the employment manager who has been recently hired and who includes plant safety among his various responsibilities. The nurse has trained 22 employees in first aid and 55 employees in cardiopulmonary resuscitation. Several individuals who are not directly employed by the plant have contributed to the occupational safety and health program. These include the senior loss prevention representative from their workers' compensation insurance carrier who visits the plant once or twice each year, a corporate safety engineer who tours the plant twice each year and a corporate nurse who has also visited the plant. Also, there is a corporate physician but he does not have any significant contact with the plant. State and Federal inspectors conduct annual radiation surveys.

At Plant 2 first aid treatment is provided by plant employees including 4 first aiders, 6 emergency medical technicians (members of the local volunteer fire department), and 16 employees trained in cardiopulmonary resuscitation. A safety committee led by the maintenance supervisor meets monthly to review OSHA reportable incidents. When an injury occurs, the employee's supervisor is notified and, if the supervisor decides that the injury requires more than first aid treatment, the employee is sent to the local emergency room which is about 1 mile away. Usually the injured employee is driven to the hospital by the supervisor or a first aider. The typical incident usually takes 2 hours before the employee returns to work.

Health Promotion and Disease Prevention

In 1978, approximately 150 employees at Plant 1 received preplacement physical examinations at a cost of $15 per examination. This compares favorably with the standard fee for that region of $45 for routine examinations. The nurse is responsible for completing a medical history questionnaire which she sends with the employee to the physician's office. Although a discount for volume is partly responsible for the low fee, it is reasonable to allocate $10 of the savings to the contribution of the nurse. If the examinations were conducted at the plant, there would be additional savings including the elimination of lost employee time. Nevertheless, the nurse's current level of

participation in the examination process represents an annual savings of $1,500 in physician's fees. Forty-seven employees are required to have annual physical examinations because of the potential hazards which exist in their jobs. These physicals include chest X-rays and complete blood counts and cost about $38 each. The nurse's role is purely administrative because these examinations are conducted at the physician's office. If these examinations were conducted at the plant, the nurse could conduct some of the clinical tests and lost time would be reduced as would the physician's fee.

During 1978, the nurse screened 400 employees for hypertension and managed a program of monthly pulmonary function screening (conducted off-site) for 9 workers with potential exposure to beryllium. Other activities included the development and presentation of educational programs on smoking, alcoholism, and self-breast examination and the provision of health education to employees who are diabetics or have relatives who are diabetics. Finally, the nurse is responsible for training employees in first aid and cardiopulmonary resuscitation, serves on the plant housekeeping and safety committees, and takes surveys of plant conditions.

Employees at Plant 2 do not receive preplacement physical examinations and no history is taken of past medical conditions or exposures to occupational hazards. A local general practitioner serves as the plant "health director"; however, he does not have regular office hours at the plant. He is utilized as a consultant and occasionally has provided immunizations and once conducted blood lead tests. He is paid about $500 to $600 for his services. The plant also utilizes the services of the workers' compensation insurance carrier. Recently the loss control specialist assisted the plant in the implementation of a safety eyeglass program.

Occupational Injury and Illness

Table 15 summarizes the occupational injury and illness experience of Plant 1, as developed from a review of the OSHA Logs and monthly injury reports. Recorded cases include all cases which required a visit to a physician or an emergency room. In addition, the monthly injury reports list the number of injuries which only required first aid. There are several other potential categories of data on these monthly reports such as calculations of frequency and severity rates but these were not recorded during the past three years. The total rate of first aid and reported incidents per 100 employees has been relatively stable over the past three years at an average annual rate of 104 incidents per 100 employees. Reported cases averaged 5 per 100 employees while first aid cases averaged 98 per 100 employees. The average lost-time case rate was about 2 per 100 employees.

In 1978, 585 occupational injuries or illnesses were recorded in the monthly reports. 543 of these cases were treated by the nurse while the remainder (42 cases) were sent to a physician. It is perceived that a most important function for the nurse is the decision she makes to treat a particular case in-plant or to send it to a physician's office or the hospital emergency room. Although the tendency is to be conservative, in cases of possible sprain or strain, the nurse often asks the employee to rest for awhile and then to return to work if the condition does not continue to warrant medical attention. When an employee is sent to a physician's office or to the emergency room, which is ½ mile away, transport is usually provided by the plant. For serious cases, a town ambulance is available. The average emergency room visit is estimated to cost $50.00.

Plant 1 participates in a corporate workers' compensation insurance policy. This policy is administered at the corporate level and the plant nurse and other plant management personnel

TABLE 15

PAIR B – PLANT 1
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

	Personnel		Total	First Aid	Reportable Cases	Cases With Days Absent	Days Away From Work	Days of Restricted Activity	Average Days/ Lost-Time Case
1978	Hourly	252	*	*	16.3	5.6	46.0	0.8	8.3
	Clerical	293	*	*	.3	0	0	0	0
	Total	545	107.3	99.6	7.7	2.6	21.3	0.4	8.3
1977	Hourly	239	*	*	8.8	3.3	50.4	0.4	15.1
	Clerical	292	*	*	.3	0	0	0	0
	Total	531	94.0	89.8	4.1	1.5	22.7	.2	15.1
1976	Hourly	242	*	*	8.7	2.1	22.3	4.3	10.8
	Clerical	293	*	*	0	0	0	0	0
	Total	535	109.7	105.8	3.9	0.9	10.1	2.0	10.8
Average 1976-1978									
	Hourly	244	*	*	11.3	3.7	39.6	2.2	11.4
	Clerical	293	*	*	.2	0	0	0	0
	Total	537	103.7	98.4	5.2	1.7	18.0	0.9	11.4

*Information not available.

receive little feed-back concerning their performance either individually or in comparison to other plants in the corporation. For the period 1976-1978 the average annual premium cost for workers' compensation insurance was $32,000 or, based upon an average employee population of 537, about $60 per employee. The plant nurse is responsible for maintaining medical records and OSHA reports. Apparently, the additional burden of paperwork interferes with her desire to develop educational and counseling programs.

At Plant 2 a daily medical record is kept in each first aid room. A review covering several months of reports revealed that the records were incomplete and of little use. The OSHA Log of Occupational Injury and Illness was compiled by an assistant in the personnel department and was reported to include all incidents which required an outside visit regardless of whether the incident met the requirements for OSHA reporting. Table 16 summarizes the occupational injury and illness experience of Plant 2, as developed from a review of the OSHA Logs of Occupational Injury and Illness for the years 1976-1978. The category of "reportable cases" includes all cases which left the plant for a visit to the emergency room or a physician's office. The incidence rate of these cases has been relatively stable at an average of about 13 cases per 100 employees for the period 1976-1978. The average lost-time case rate for the same period was about 4 cases per 100 employees. The average duration of a lost-time case was about 13 days.

In 1978, the plant had 8 compensable injuries at an average cost of about $282 for the 6 cases which were closed as of 1 December 1978, and 60 "medical only" cases at an average cost of $47 each. The 2 open cases will incur substantially greater costs. For the period 1976-1978, the average annual premium cost for workers' compensation insurance was $41,000 or, based upon an average employee population of 424, about $97 per employee. The personnel department was concerned that cases were not monitored and there were no effective mechanisms for assuring the timely return of employees to work. It was felt that the waiting period for collecting compensation or indemnity payments was a disincentive for prompt return to work.

Nonoccupational Injury and Illness

Employees are encouraged to utilize the services of the nurse for nonoccupational health problems. The nurse is an advocate of health counseling and health education and serves as a resource for the employee population. Data were not available on the volume or nature of nonoccupational visits. The plant nurse cares for a number of employees with chronic health problems and follows the private physician's orders to provide services for 1-2 employees per week. Plant employees are eligible for coverage under a corporate comprehensive medical and dental plan. Although the plant nurse often assists employees with completing insurance claims forms, she does not receive reports on the plant's performance under the plan. This is because employees file their own claims and the plan is administered at the corporate level.

The only related service which Plant 2 provides is a standard medical insurance policy. The total premium rates ($21.43/single and $61.62/family on a monthly basis) appear to be extremely low which may be due to the low average age of the employees and the effect of experience rating on such a population.

DISCUSSION

Lacerations and back strains are the most prevalent occupational conditions at Plant 1. Lacerations are difficult to prevent where requirements for manual dexterity limit the applicability of

TABLE 16

PAIR B – PLANT 2
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

	Personnel		Total	First Aid**	Reportable Cases	Cases With Days Absent	Days Away From Work	Days of Restricted Activity	Average Days/ Lost-Time Case
1978	Hourly	367	*	*	17.7	6.3	48.6	0	7.8
	Clerical	167	*	*	.6	0	0	0	0
	Total	534	36	23	12.3	4.3	33.4	0	7.8
1977	Hourly	292	*	*	15.8	4.8	108.4	2.4	22.6
	Clerical	151	*	*	3.3	1.3	1.0	0	.75
	Total	443	40	28	11.5	3.6	71.8	1.6	19.9
1976	Hourly	177	*	*	23.2	6.8	89.3	0	13.2
	Clerical	118	*	*	.8	.8	8.5	0	10
	Total	295	57	42	14.2	4.4	57.0	0	12.9
Average 1976-1978									
	Hourly	279	*	*	18.9	6.0	78.1	.8	13.4
	Clerical	145	*	*	1.6	.7	2.6	0	3.8
	Total	424	42	30	12.7	4.1	52.2	.5	12.8

*Information not available.
**Estimated from informal First Aid log.

personal protective equipment. In this situation the nurse could identify problem areas in the operation while treating injuries as they occur. Identification may lead to preventive measures while in-plant treatment eliminates lost time and can guard against the complications of infection. Back strain injuries are difficult to control, partly because of the subjective nature of the diagnosis. The nurse can help to verify diagnoses as well as provide therapy which may limit the duration of lost time. Plant 1 could greatly improve their nursing program by developing better cooperation between the nurse and local physicians, by conducting physical examinations and tests on-site, by vigorously following compensation cases to reduce lost time, and, most importantly, by transferring the bulk of paperwork to clerical staff so that the nurse could devote her time to improving plant safety and health.

The corporate personnel director at Plant 2 is actively seeking to employ an occupational health nurse even though he has not developed any quantitative expectations of benefits. Actually, the proposed job description is not for a plant nurse but for a "corporate" nurse who will provide nursing services at the main plant while also managing occupational safety and health for the company including several plants in other parts of the country. The management functions will make good use of the nurse's skills; however, this role should not be allowed to overshadow the importance of providing nursing service at the plant level. Given the rapidly expanding employee population, there will be an increasing need for in-plant nursing care as well as health promotion and disease prevention activities.

COMPARISON OF COSTS AND BENEFITS

PROGRAM COSTS

We have estimated that the direct cost of the nursing program in Plant 1 was about $21,000 per year, which is equivalent to about $37 per employee or $78 per hourly employee. A portion of these costs would have been incurred even if there were no nursing program: namely, the cost of a first aid program, and the time for preparing reports for agencies such as OSHA (Table 17).

TABLE 17

PAIR B – PLANT 1
NURSING PROGRAM COSTS (1978)

Item	Cost
R.N. Salary	$13,000
Fringes @ 38%	4,940
Supplies	1,000
Space (400 sq. ft. @ $6)	2,400
Total	$21,340

PAIR B – PLANT 2
FIRST AID PROGRAM COSTS (1978)

Item	Cost
Space (160 sq. ft. @ $6)	$ 960
Supplies	750
Courses and Materials	200
Total	$1,910

PAIR B – PLANT 1
NURSING PROGRAM NET COSTS (1978)

Item	Cost
Direct Cost	$21,000
Less: First Aid Offset	1,300
Less: Reporting Offset	4,500
Net Cost	$15,200

Cost of First Aid Activities

The first aid program at Plant 2 was estimated to cost about $1,900 per year, which is equivalent to about $5.20 per hourly employee. If the same costs were to apply to Plant 1, the first aid program would have cost $5.20 x 252 hourly employees = $1,300. This estimate may be considered to be an offset against the actual cost of the nursing program.

Cost of Reporting Activities

The cost of the time associated with reporting activities can be estimated in several ways:

- About 28% of the plant nurse's time is associated with administrative activities, which presumably would have to be performed by someone else if there were no plant nurse. The cost of this time is estimated to be 28% x $18,000 (nurse's salary plus 38% fringe benefits) = $5,040.
- If we assume that a lower-salaried person could perform these functions and that it would require 28% of that person's time, then the cost would be 28% x $10,000 x 138% = $3,900, assuming an annual clerical salary of $10,000 and fringe benefits of 38%.

Net Program Costs

The net cost of the occupational health nursing program is therefore equivalent to the direct costs ($21,000) less the offsetting costs of first aid ($1,300) and reporting ($4,500) for a net cost of $15,200. This is equivalent to about $28 per employee or $60 per hourly employee on an annual basis.

PROGRAM BENEFITS TO THE EMPLOYER

Direct Benefits to the Employer

The direct benefits to the employer which accrue from having an occupational health nursing program are quantitative financial benefits. Three distinct areas of benefit have been identified.

Physical Examination Costs

In plant 1 the nurse handles the preliminary paperwork and completes the medical history questionnaire. Since the actual examination is conducted in the physician's office, the benefits of the plant nurse's activity are limited to administrative details. By comparing the physician's charge to the plant with typical charges for such examinations it was determined that the plant saves $30 on each examination. Since some of this savings is likely to be due to a discount for the volume of examinations, only $10 has been allocated as a savings due to the activities of the plant nurse, which on an annual basis is a total of $1,500.

Insurance Costs

- Workers' Compensation Loss Experience — Based upon the difference in their premium costs for workers' compensation insurance, Plant 1 appears to be saving $37 per employee or, with an average employee population of 537 for 1976-1978, an average annual savings of about $20,000. Such a savings is more than sufficient to offset the cost of the nursing program. On the other hand, the nursing program may not be the only factor responsible for this difference. Factors such as safety conditions, work ethics, regional medical costs, and differences in base salaries may affect insurance premiums either by an impact on experience or as a factor in the rate calculations.
- OSHA Logs of Occupational Injury and Illness — The OSHA Logs for the years 1976-1978 were reviewed at both Plant 1 and Plant 2. The comparison of these plants provides additional information to assess the benefit of an occupational

health nursing program. It is fortunate, in this case study, that both plants followed a similar recording procedure which was to record all cases of occupational illness or injury which left the plant for treatment. Therefore, the OSHA Log includes cases which do not conform to the requirements of OSHA recordability (e.g., first aid treatment provided by a physician). On the other hand, it is unlikely that cases, which were "recordable" according to the definition, would be omitted from the Logs. Since the OSHA Logs apparently represent most of the cases which received outside attention, either first aid or medical treatment, they also represent a substantial proportion of the cases which incurred costs that are compensable under workers' compensation insurance.

As noted in Table 18, the average total recorded case rate was 11.3 per 100 hourly employees from 1976-1978 for Plant 1, compared with 18.9 for Plant 2. The difference between plants is an average 7.6 cases per 100 hourly employees. Thus, for Plant 1, which had an average of 244 hourly employees from 1976-1978, it is inferred that the occupational nursing program has contributed to an average reduction of 20 cases. At an average cost of $50 per case (assuming the reduction is in the more minor medical cases), the annual savings due to such a reduction in the case rate is $1,000 in direct (workers' compensation reimbursed) costs. Since a compensation case has a long-term impact on premium calculations which may range from 1.5 to 2.4 times the actual cost, the actual savings may range from $1,500 to $2,400. The table also shows a lower rate for lost-time cases and a somewhat shorter average case duration for Plant 1 compared with Plant 2.

- Nonoccupational Medical Costs — Both Plant 1 and Plant 2 have group medical insurance programs which are carried by different insurance companies. Because of inconsistencies in the benefit structures of the two programs, direct comparisons are not possible.

Lost Production Time

The 20 cases which may have been prevented by occupational nursing activities would normally result in a considerable amount of lost production time. Assuming a duration of 2 hours for a visit to a physician or the emergency room, this results in 40 hours of lost time and, at a base hourly rate of $7.50, this represents a loss of about $300. Since the employee is paid for this time away from work, it is the employer's loss of wages paid without productive work. For nonoccupational problems, the employee himself may lose wages for lost time.

Indirect Benefits to the Employer

Indirect benefits are difficult to quantify, but, nevertheless, are generally acknowledged as being significant economic factors. They include the value of production which is lost due to employee absence and effects on morale and employee relations which can directly affect productivity or indirectly affect the quality of the product.

Value of Lost Production

The economic impact of lost production time due to employee absence is not likely to be a result of losses in sales but rather it may result from increased costs due to overtime labor requirements. Such an impact will be more severe in thriving industries such as electronics which are already operating at peak capacity than in slower industries which can adapt to fluctuations in activity.

TABLE 18

COMPARISON OF PAIR B – PLANTS 1 AND 2

	Plant 1			Plant 2			Difference		
	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case
1978	16.3	5.6	8.3	17.7	6.3	7.8	1.4	0.7	(0.5)
1977	8.8	3.3	15.1	15.8	4.8	11.6	7.0	1.5	7.5
1976	8.7	2.1	10.8	23.2	6.8	13.2	14.5	4.7	2.4
Average	11.3	3.7	11.4	18.9	6.0	13.4	7.6	2.3	2.0

*Cases per 100 production employees.

Morale and Employee Relations

Occupational health nursing services may be an important factor in maintaining a high level of employee morale and good relations between labor and management. However, data are not available to make a quantitative assessment of this benefit.

PROGRAM BENEFITS TO THE EMPLOYEE

Direct Benefits to the Employee

An occupational health nursing program can provide a direct economic benefit to employees by reducing the amount of wages lost due to out-of-plant medical visits and savings on expenses for nonoccupational ambulatory care. Although little data was available to describe this activity, it was learned that 1-2 employees are seen each week for treatment of chronic health problems under a private physician's orders. Over a year this might amount to 75 visits which would cost about $15 each or a total of $1,100 if the nurse was not available. Additional lost wages could also amount to $1,100.

Indirect Benefits to the Employee

It is not possible to quantify the benefits to employee health and morale which nursing activities provide. For example, hypertension screening is a service which could identify potentially life-threatening conditions.

DISCUSSION

The Plant 1 nursing program is estimated to have an annual net cost of about $15,000. Associated with this cost are both direct and indirect benefits which accrue to the employer and the employee. The values of some direct benefits have been estimated:

• Savings on preplacement physical examinations.	$1,500
• Savings based upon OSHA Log comparisons.	$1,500-$2,400
• Savings based upon differences in workers' compensation premiums.	$20,000
• Savings on wages paid without production.	$300
• Saved wages for employees for nonoccupational conditions.	$1,100
• Savings on employee medical costs.	$1,100

Note that these benefits are not all additive. Also, indirect benefits have been identified and, although information is not available to make quantitative estimates, they (as well as unquantified direct benefits) should be considered in the assessment of benefits. In this case study, the most dramatic measure of benefit is the difference in workers' compensation insurance premiums. Even if some of this difference is due to other, previously mentioned, factors, a substantial benefit remains which, when considered with other likely direct and indirect benefits, is probably sufficient to outweigh the cost of the nursing program.

CASE STUDY C
TEXTILE PLANTS

PLANT 1: WITH AN OCCUPATIONAL HEALTH NURSING PROGRAM

PLANT 2: WITHOUT AN OCCUPATIONAL HEALTH NURSING PROGRAM

At Plant 1 the main building is about 50 years old with 3 floors and a total of 480,000 square feet of floor space. A second small facility is also 50 years old and has a total of 60,000 square feet on 2 floors. In addition, there is a small warehouse which covers 80,000 square feet. The conditions in the plant vary widely from recently renovated areas to old, dark and dusty areas. The plant manufacturers non-woven cotton and synthetic textiles, some of which are converted at the plant to finished products such as bandages and sterile dressings. Basically, the manufacturing process is divided into 2 production lines (1) cotton processing and bleaching and (2) chemical processing of synthetic fibers. Within these 2 general areas are several specific product stations which include automatic cutting, folding and wrapping operations. Packaging operations tend to be manual.

Plant 2 occupies a 5 story 100-year old granite building. The total floor space is 215,000 square feet. The plant manufactures upholstery fabric from synthetic and natural materials. The basic unit operations include raw materials storage, weaving, warping and beaming, seaming, rolling, packaging, shipping, and machine maintenance.

The manufacturing processes may be characterized in terms of their most significant hazards and the occupational injury or illness which may result from exposure to these hazards. The primary concerns are lacerations and other cuts from sharp instruments and moving machinery, sprains and strains from handling heavy rolls of materials, and chemical burns. Exposures to noise and dust, particularly cotton dust, are also concerns. A review of the OSHA Logs of Occupational Injury and Illness (Table 19) for the years 1976-1978 reveals the types of injury and illness which have resulted from these exposures. In addition to the expected cases of lacerations, sprains, strains and burns, it was surprising that there were so many fractures (22 cases) and eye injuries (16 cases) at Plant 1. There were also a considerable number of back strains and fractures at Plant 2. All entries in their Log were recorded as injuries including illness cases such as chest pain (1 case), dizziness and headache (1 case), rash (1 case), seizure (2 cases), and swollen insect bite (2 cases).

WORK FORCE CHARACTERISTICS

The number of employees by year is shown in Table 20. During the past several years there has been a decline in the number of hourly employees at Plant 1. At the time of the survey, there were about 300 hourly employees. This group is predominantly (75%) male. The only significant minority group is Portuguese who represent 16% of the hourly employees. The plant runs on 3 shifts with about 30% of the work force on the second shift and 13% on the night shift. The hourly employees have been represented by the Amalgamated Clothing and Textile Workers Union for 34 years. In recent years there have been no work stoppages except for regularly scheduled summer vacations.

TABLE 19

PAIR C – PLANTS 1 AND 2
REPORTED OCCUPATIONAL INJURY AND ILLNESS
1976-1978

Type of Injury or Illness	Number of Reported Cases 1976-1978	
	Plant 1	Plant 2
Laceration/Other Cuts	53	61
Contusion/Abrasion	43	47
Sprain/Other Strain	35	31
Back Strain	23	31
Fracture	22	9
Foreign Body/Chemical in Eye	16	1
Chemical/Other Burn	9	1
Occupational Illness/		
Dermatitis	4	0
Dizziness	1	0
Eye/Allergic Reaction	1	0
Other Cases	8	8

TABLE 20

PAIR C – PLANTS 1 AND 2
EMPLOYEE POPULATIONS

	1978		1977		1976	
	Plant 1	Plant 2	Plant 1	Plant 2	Plant 1	Plant 2
Hourly/Production	325	254	356	243	358	249
Salary/Clerical	80	22	80	22	80	22
Total	405	276	436	265	438	271

During the past several years the employment level has been relatively constant at Plant 2. At the time of the survey there were approximately 285 employees. The ethnic e background of the work force is predominantly Portuguese and they are mostly (93%) male. The plant operates 3 shifts, 5 or 6 days per week depending upon demand. It was estimated that about 120 of the hourly employees work on the first shift with the remainder on the second and night shifts. There have been no major work stoppages in recent years except for a regularly scheduled 1 week vacation in the summer. The plant is not unionized.

OCCUPATIONAL SAFETY AND HEALTH PROGRAMS

Management Attitudes Toward Occupational Safety and Health

At Plant 1 the nurse, as well as the labor relations manager and personnel assistant, report directly to the personnel manager who reports to the plant manager. Although the plant does not have a specific policy on occupational safety and health, the personnel director expressed his own belief that the nurse "pays for herself." He felt that the primary benefits of having a nurse were:

- Reducing the number of outside trips for first aid or nursing care.
- Controlling for lost-time due to illness or injury.
- Providing a "security blanket" for employees.
- Caring for employees with chronic medical problems.

Plant 2 does not have a nurse. The office manager reported that this was a corporate decision based upon the small size of the employee population. Programs related to occupational safety and health are conducted by the office manager.

Program Facilities and Equipment

The nursing facility occupies about 600 square feet and consists of an office, 2 treatment and examination areas with 2 beds, a heat lamp, eye examination chair with magnifier, a large central waiting area, a laboratory, and storage areas. The facility is equipped with routine first aid supplies and over-the-counter drugs.

Plant 2 has has a first aid room which covers 140 square feet. It is equipped with basic first aid supplies. It also includes a booth for audiometric testing.

Program Description and Personnel

Plant 1 has had a registered nurse for more than 36 years. The current nurse has been at the plant for about 1 year. Prior to her arrival, they had a part-time nurse for several months. Previously, she has worked in both medical and surgical hospital units and spent the most recent 5 years working in an alcohol detoxification unit. The nurse works full-time and she estimated that her time might be allocated into 6 general categories (Table 21).

The nurse commented that her prior experience in the detoxification unit was particularly helpful preparation for her current position. In contrast to hospital nursing she finds that, as an occupational nurse, she must be able to work without the direct supervision of a physician and to spend more time with each individual. She noted the variety of her job and remarked that teaching subjects such as health care, nutrition, and exercise was an important part of her job.

TABLE 21

PAIR C – PLANT 1
ALLOCATION OF NURSING ACTIVITIES

Activity	Hours/Week	% of Time
First Aid	10	25
Paper Work	10	25
Physical Therapy/Dressing Changes, etc.	6	15
Safety Programs	6	15
Counseling/Referrals	4	10
Health Education	4	10
Total	40	100%

The plant uses a local internist for preplacement physical examinations which are conducted at the physician's office. He also treats minor occupational injuries and illnesses or helps to refer the cases to specialists. Although the physician is nominally the plant physician, he does not have office hours at the plant. Additional plant personnel who contribute to the occupational safety and health program include the assistant personnel supervisor who is in charge of plant safety. Also, on the day shift there is an emergency medical technician and 18 first aiders, 3 of whom are trained in cardiopulmonary resuscitation. Additionally, there are 6 first aiders on the second shift and 5 on the night shift. This plant belongs to a subsidiary of a large corporation; however, they receive little assistance for occupational safety and health. They do have monthly visits from the regional loss control specialist of their workers' compensation insurance carrier. They also have quarterly visits from an occupational nurse consultant.

At Plant 2 the office manager is assisted by 10 employees who are trained in first aid. Six of these first aiders are also trained in cardiopulmonary resuscitation. The office manager is a certified industrial audiometric technician and a certified occupational hearing conservationist. There is also a safety committee which meets quarterly to review cases and improve working conditions. Physical examination and other relevant medical records are kept in each employee's personal folder. The plant prepares quarterly summaries of lost-time cases in addition to the OSHA Log of Occupational Illness and Injury which was reported to include all cases which required outside treatment. The plant physician does not have office hours at the plant. In fact, his only recent visit was to administer influenza vaccine. The plant is surveyed quarterly by a loss prevention specialist from the workers' compensation insurance carrier.

Health Promotion and Disease Prevention

At Plant 1 preplacement physical examinations are conducted by the plant physician who has a nearby office. At the plant the nurse takes a medical history; measures height, weight, and blood pressure; and tests urine for sugar and acetone. The physician does a hands-on physical which

does not include any laboratory work or radiology. He charges the plant $20 for this examination while his normal charge is $40. During 1978 there were 70 such examinations representing a savings of 70 x $20 = $1,400.

The nurse is responsible for a number of programs including programs for quitting smoking, diabetes, and hypertension screening. She also runs a "Bingo" game in which employees are eligible to win prizes for every day without an occupational injury. Although such a system appears to be useful in focusing attention on health and safety, there is a disincentive to report injuries which must be controlled.

The plant nurse monitors a number of employees who might otherwise have required visits to a physician. In particular, this includes cases of hypertension and diabetes. In addition, during screenings or other visits the nurse occasionally detects serious chronic conditions. For example, the performance of a custodian was poor and he was persuaded to see the plant nurse. She discovered that he had trouble with his vision and, in fact, was developing cataracts. The early identification of this problem and prompt medical treatment probably helped to save this man from going blind. Another employee complained of general malaise. Upon examination the plant nurse insisted that he receive immediate medical attention. It was later discovered that he had an undiagnosed cardiac condition and he was placed in the intensive care unit.

Plant 2 utilizes the services of a local general practitioner for preplacement physical examinations. An employee who is absent for more than 30 days is also required to visit the physician. The typical examination is a brief hands-on examination without any laboratory testing or X-rays. The usual fee is $12. The plant has a very low turnover rate so that only about 2 new employees are examined each year. The office manager spends about 1 hour per week conducting a hearing conservation program for about 200 employees who have been identified as working in high noise level areas.

Occupational Injury and Illness

Table 22 summarizes the occupational injury and illness experience of Plant 1 for the period 1976-1978. The summary was compiled from data recorded in the OSHA Log of Occupational Injury and Illness which was reported to include most of the cases which required treatment outside of the plant. Thus, the Log includes cases which are not "reportable" such as first aid provided by a physician or diagnostic radiology with negative results. A first aid log is also kept by the plant nurse but it is incomplete except for the most recent few months. Using the OSHA Log data, the average annual case rate was 17.5 cases per 100 employees. The average lost time case rate was 6.8 per 100 employees and the average duration of a lost-time case was about 19 days.

During the day shift the nurse provides first aid for minor occupational injuries. Cases which require additional treatment are sent to the plant physician, to the emergency room of the hospital which is five miles away, or to local specialists. Minor injuries which occur on the second or night shifts are treated by the first aider on duty with follow-up by the nurse. The nursing service overlaps with the beginning of the second shift and twice weekly the nurse comes to the plant before the night shift ends. With this schedule all employees have the opportunity to utilize the service. The nurse explained that workers who receive minor injuries on the second and night shifts are treated by a first aider and are encouraged to visit the nurse before seeking further treatment.

TABLE 22

PAIR C – PLANT 1
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

		Personnel	Reportable Cases	Cases With Days Absent	Days Away From Work	Average Days/ Lost-Time Case
1978	Production	325	26.2	11.4	160	14.1
	Administrative	80	2.5	0	0	0
	Total	405	21.5	9	128	14.1
1977	Production	356	16.9	8.4	217	25.7
	Administrative	80	2.5	0	0	0
	Total	436	14.2	6.9	177	25.7
1976	Production	358	20.7	5.6	103	18.5
	Administrative	80	0	0	0	0
	Total	438	16.9	4.6	84	18.5
Average 1976-1978						
	Production	346	21.3	8.5	160	19.1
	Administrative	80	1.7	0	0	0
	Total	426	17.5	6.8	130	19.1

A review of recent bills indicated that the emergency room fee ranges from $16.50 to $21.50 for relatively minor injuries and that the minimum physician's fee is about $15 to $20 excluding charges such as for minor surgery or radiology. It appears that the total average charge for an emergency room visit is about $75. In addition, there is at least 2 hours of lost-time if the employee drives himself and more time if the nurse or security guard accompanies the injured employee. The nurse reviewed the first aid log for a recent 10-week period during which 200 visits were recorded. This is equivalent to about 1,000 visits/year. Sixty percent of these visits were occupationally related and were predominantly production employees.

The plant nurse changes dressings and provides physical therapy. The availability of these services facilitates the return to work of an injured employee and reduces the number of visits to a physician. The nurse cited several examples:

- An employee was required to have his dressing checked and changed daily for 6 days. Since the nurse provided this service, the plant saved the expense of 6 physician visits and, most likely, the cost of 6 days of lost time.
- Another employee had a back injury and required warm soaks twice daily for 3 days. The nurse remarked that at one point in time she was treating 7 such cases. Likewise, persons with ankle sprains and similar injuries may receive physical therapy.

Over the course of a year, the nurse estimated that about 20 person-weeks of lost-time and associated medical costs were averted because this type of service was available in the plant.

For long-term absences the nurse maintains contact with the employee by telephone or often the employee comes to visit the nurse. Where possible and in consultation with a physician, the nurse tries to find an alternate position for the employee. For example, an employee had multiple sutures on a finger and arrangements were made with the supervisor for a temporary position which would not aggravate the injury and which the employee was capable of doing. This effort averted an estimated loss of 2 weeks.

The plant participates in a workers' compensation insurance policy which is experience-rated on a corporate basis. The corporate benefits manager explained that the loss experience at this particular plant was poor. They have seen claims (including payments and reserve) increase dramatically in the past few years. In 1978, the plant paid about $106,000 in premiums with a claims total of about $156,000 which suggests that experience rating will call for future premium increases. This may be due to the high incidence of back strain and fracture cases which generally require long convalescence.

Table 23 summarizes the occupational injury and illness experience at Plant 2, as developed from a review of the OSHA Log of Occupational Illness and Injury for the years 1976-1978, which was reported to include those cases which required outside treatment. The quarterly plant summary of industrial accidents was also reviewed and an estimate of the first aid case rate was made by comparing this data to the OSHA Log data. The average annual total rate for the period 1976-1978 was 27.8 cases per 100 employees. The rate for cases recorded in the OSHA Log was 21.4 cases per 100 employees of which 4.8 cases per 100 employees incurred lost-time. The average duration of a lost-time case was 15.8 days.

TABLE 23

PAIR C – PLANT 2
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

		Personnel	Total	First Aid*	Reportable Cases	Cases With Days Absent	Days Away From Work	Average Days/ Lost-Time Case
1978	Hourly	254	26.4	10.6	19.7	6.7	73.6	11.0
	Salary	22	4.5	0	4.5	0	0	0
	Total	276	24.6	9.8	18.5	6.2	67.8	11.0
1977	Hourly	243	32.1	12.8	19.3	4.5	45.3	10.0
	Salary	22	0	0	0	0	0	0
	Total	265	29.4	11.7	17.7	4.2	41.5	10.0
1976	Hourly	249	31.7	1.6	30.1	4.4	117.3	26.5
	Salary	22	0	0	4.5	0	0	0
	Total	271	29.5	1.5	28.0	4.1	107.7	26.5
Average 1976-1978								
	Hourly	248.7	30.1	8.7	23.0	5.2	78.7	15.8
	Salary	22.0	1.5	0	3.0	0	0	0
	Total	270.7	27.8	7.7	21.4	4.8	72.3	15.8

*Estimated from sample.

Injured employees are treated by the office manager or by one of the first aiders. For more serious injuries the employee is sent to the local hospital emergency room which is about ½ mile away. A typical visit to the emergency room requires 2½ hours and in 75% of the cases the injured employee is accompanied by a driver. The average fee for an emergency room visit is between $20 and $30, excluding radiology or other diagnostic tests.

Nonoccupational Injury and Illness

Employees are encouraged to use the nurse for nonoccupational problems. Such a service is thought to have significant impact on the level of absenteeism. During a year approximately 40% or 400 of the visits to the nurse are for nonoccupational conditions. Of these visits 55% are production employees and 45% are salaried employees. Employees participate in a medical insurance program with standard provisions for deductibles. Because of favorable experience the rates are going to be reduced.

Plant 2 does not provide any services to care for nonoccupational conditions. Although no data were available, it appears that this is not a major problem for the plant. The highly ethnic male nature of the work force may be a behavioral factor which indirectly reduces absenteeism because these workers tend to ignore those health conditions that lead to absenteeism in other groups.

DISCUSSION

The review of reported types of injury and illness suggests that a strict program requiring safety eyeglasses and safety shoes would be a substantial benefit to Plant 1. Although the manufacturing process would not appear to warrant a hard hat program, a number of the lacerations and contusions were head injuries. Clearly, some preventive action is needed especially given the substantial and increasing costs of workers' compensation insurance. The nurse should take the initiative in organizing plant and corporate staff as well as labor representatives to improve plant conditions, develop protective equipment programs, and control occupational injury and illness cases with in-plant treatment and diligent follow-up.

Plant 2 was unique in having an audiometric screening program. More unusual was the fact that this program was directed by the office manager rather than by a nurse. It appears that this program developed partly out of the interest of the office manager himself and partly as a response to future liability issues rather than as part of general policy toward occupational safety and health. It is unfortunate that data was not available on workers' compensation costs because the OSHA Logs suggest that the plant may have incurred excessive expenses for cases of occupational injury and illness. Such data might give a better description of the problem and might suggest whether or not a nurse would be beneficial in reducing these costs.

COMPARISON OF COSTS AND BENEFITS

PROGRAM COSTS

We have estimated that the direct cost of the nursing program in Plant 1 is about $20,000 per year, which is equivalent to about $49 per employee, or $62 per hourly employee (Table 24). A portion of these costs would have been incurred even if there were no nursing program: namely, the cost of a first aid program and the time for preparing reports for agencies such as OSHA.

TABLE 24

PAIR C – PLANT 1
NURSING PROGRAM COSTS (1978)

Item	Cost
R.N. Salary	$12,000
Fringes @ 33%	4,000
Supplies	900
Space (600 sq. ft. @ $5)	3,000
Courses and Journals	100
Total	$20,000

PAIR C – PLANT 2
FIRST AID PROGRAM COSTS (1978)

Item	Cost
Space (140 sq. ft. @ $5)	$ 700
Supplies	250*
Courses	50
Total	$1,000

PAIR C – PLANT 1
NURSING PROGRAM NET COSTS (1978)

Item	Cost
Direct Cost	$20,000
Less: First Aid Offset	1,280
Less: Reporting Offset	5,000
Total	$13,720

*Excluding amortized cost of audiometric equipment with a purchase price of $500-$700.

Cost of First Aid

The first aid program at Plant 2 was estimated to cost about $1,000 per year, which is equivalent to $3.94 per hourly employee. If the same cost were to apply to Plant 1, then the first aid program would have cost $3.94 x 325 hourly employees = $1,281. This estimate may be considered an offset against the actual cost of the nursing program.

Cost of Reporting Activities

The cost of the time associated with reporting activities can be estimated in several ways:

- About 25% of the plant nurse's time is associated with administrative activities, which presumably would have to be performed by someone else if there were no plant nurse. The cost of this time is estimated to be 35% x $16,000 (nurse's salary, plus 33% fringe benefits) = $5,600.
- Assuming that a lower-salaried person could perform these functions and that it would also require 35% of that person's time, then the cost would be 35% x $10,000 x 133% = $4,655, assuming an annual salary of $10,000 and fringe benefits of 33%.

The cost of reporting activities is therefore estimated to be about $5,000.

Net Program Costs

The net cost of the nursing program is therefore estimated to be the direct costs ($20,000) less the offsetting costs of first aid ($1,280) and reporting ($5,000) for a net cost of $13,720. This net cost is equivalent to about $42 per hourly employee per year.

PROGRAM BENEFITS TO THE EMPLOYER

Direct Benefits to the Employer

The direct benefits to the employer which accrue from having an occupational nursing program are quantitative financial benefits. Three distinct areas of benefit have been identified.

Physical Examination Costs

The plant nurse handles much of the preliminary paperwork, takes basic measurements and conducts some clinical tests which result in savings to the plant of about $20 on each physical examination. During 1978 there were 70 such examinations for a total savings of $1,400. Plant 2, on the other hand, has a low rate of turnover so that few physical examinations are conducted and the examination itself is brief and, therefore, not particularly expensive.

Insurance Costs

Table 25 presents a comparison of the two plants based upon the rates per 100 employees of cases reported in the OSHA Log. The difference between the plants is small and, in fact, suggests that Plant 2 has had better experience in terms of limiting the duration of lost time from work.

As previously mentioned, this may be related to personal characteristics and attitudes of the work force at Plant 2, rather than the presence or absence of a nurse. Information is not available to compare insurance premium costs; however, based upon the OSHA Log data, dramatic differences would not be expected.

TABLE 25

COMPARISON OF PAIR C – PLANTS 1 AND 2

	Plant 1			Plant 2			Difference		
	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case	Reported* Cases	Cases With* Days Absent	Average Days/ Lost-Time Case
1978	26.2	11.4	14.1	19.7	6.7	11.0	6.5	(1.7)	(3.1)
1977	16.9	8.4	25.7	19.3	4.5	10.0	(2.4)	(3.9)	(15.7)
1976	20.7	5.6	18.5	30.1	4.4	26.5	9.4	(1.2)	8.0
Average	21.3	8.5	19.1	23.0	5.2	15.8	1.7	(3.3)	(3.3)

*Cases per 100 production employees.

From the point of view of managers at Plant 2, in 1978 this plant recorded 51 cases in the OSHA Log and an additional 27 first aid cases were identified from plant data. If a nurse could handle 20 of the 51 cases without incurring additional outside costs, this would result in an estimated savings of $55 x 20 cases = $1,100 in workers' compensation reimbursed medical costs, and a potential impact on insurance premiums of $1,700 to $2,800. Reduced time away from work would result in additional savings.

Another approach is to evaluate the current demand for nursing services at Plant 1, where on an annual basis 600 occupational cases and 400 nonoccupational cases are treated by the plant nurse. In this case, assuming that 10% of the occupational cases might require outside medical attention if the nurse was not present, the result is a savings of $55 x 60 = $3,300 which could result in a savings of $5,000 to $8,000 on future workers' compensation premium costs.

Lost Production Time

Time away from work for treatment of occupational conditions results in the payment of wages without related production. For the 60 cases at Plant 1, the nursing service could save about 120 hours of lost time which, at an average hourly rate of $5.75, would result in a savings of $690 for the employer.

Indirect Benefits to the Employer

In addition to the many direct benefits which have been addressed previously, the personnel manager at Plant 1 specifically noted their low rate of absenteeism which he attributed, in part, to the availability of in-plant nursing services.

PROGRAM BENEFITS TO THE EMPLOYEE

Direct Benefits to the Employee

The plant nurse reported that about 400 cases of nonoccupational injury or illness were treated each year. Although most of these cases are minor, some would require a physician or hospital emergency room visit if the nurse was not available. Assuming that between 1% and 10% of the cases would require such treatment at a minimum cost of $20, the total cost would be $80 to $800. The loss of wages would total $11.50 per visit for a total of $46 to $460. These would be direct costs to the employee, because they would probably not exceed the deductible provisions of an individual's medical insurance policy.

Indirect Benefits to the Employee

The primary indirect benefit which has resulted at Plant 1 is related to the nurse's activities in health promotion and disease prevention. Examples have been cited where her intervention led to the early identification and treatment of serious health problems.

DISCUSSION

The Plant 1 nursing program is estimated to have an annual net cost of about $14,000. Associated with this cost are both direct and indirect benefits which accrue to both the employer and the employee. The values of some direct benefits have been estimated:

- Savings on preplacement physical examinations. $1,400
- Plant 2 potential savings from reducing outside first aid. $1,700 to $2,800

• Plant 1 reduced outside medical treatment of first aid cases.	$5,000 to $8,000
• Savings on wages paid without production.	$700
• Saved wages for employees for nonoccupational conditions.	$46 to $460
• Savings on employee medical costs.	$80 to $800

Note that these benefits are not all additive. Also, indirect benefits have been identified and, although information is not available to make quantitative estimates, they should be considered for a complete assessment of benefits.

From the limited data available for this case study, it is difficult to completely write off the cost of the nursing program with quantitative estimates of savings. Certainly a major factor for consideration is the potential value of indirect benefits which would have to account for a substantial portion of the cost at Plant 2. On the other hand, at Plant 1 the nurse appears to provide more direct benefits by treating cases that would otherwise incur outside medical costs.

CASE STUDY D
CLOTHING PLANTS

PLANT 1: WITH AN OCCUPATIONAL HEALTH NURSING PROGRAM

PLANT 2: WITHOUT AN OCCUPATIONAL HEALTH NURSING PROGRAM

PHYSICAL PLANT AND PRODUCTION PROCESSES

Plant 1 is about 9 years old. The facility includes the knit-wear plant, the corporate offices, a warehouse distribution center, and a small factory store covering a total ground floor area of approximately 95,000 square feet. About 38,000 square feet of ground space is devoted to production while most of the remainder is for warehousing. The plant produces knitted garments, predominantly sweaters, shirts, dresses, and skirts, from synthetic yarns. Fabric is knitted by a highly automated process on circular, flat, or frame knitting machines. Examining and washing processes are followed by cutting and slicing fabric panels and sewing these panels to form garments. Finished garments are inspected, mended, pressed, and packed for shipping or storage in the warehouse.

Plant 2 is a subsidiary of the parent corporation which owns Plant 1. The plant occupies the third and fourth floors of a large, 100-year old, granite and brick building. Each floor is approximately 50,000 square feet in area. The processes employed and products manufactured are similar to those found at Plant 1; however, the layout and production flow differ considerably.

The manufacturing processes may be characterized in terms of their most significant hazards and the occupational illness or injury which may result from exposure to these hazards. The primary concerns are lacerations from using fabric cutting instruments and puncture wounds while operating or maintaining the knitting machines. Projectiles generated when needles break may cause eye injuries. Cleaning and washing operations may result in burns, or dermatitis may develop from exposure to chlorinated solvent spotting solutions. A review of the OSHA Logs of Occupational Injury and Illness (Table 26) for the years 1976-1978 reveals the types of injury and illness which have resulted from these exposures. Lacerations and other cuts, contusions, and abrasions comprise nearly 50% of the reported injuries. Another prevalent injury category is back strain. Although the manufacturing processes do not require heavy lifting, improper lifting of moderate loads or abrupt movements may be sufficient to cause back injury. Plant 2 reported 1 case of occupational dermatitis.

WORK FORCE CHARACTERISTICS

The number of employees by year is shown in Table 27. In addition to the manufacturing plant, the Plant 1 location also has the warehouse/distribution center, and is the corporate headquarters for the company. The total current employee population is 650, which includes 240 manufacturing employees and 100 warehouse employees. Furthermore, there are 60 employees associated with design operations; 20 staff in the factory clothing store, which is located in the same building; and 125 clerical and 100 salaried staff. Although all employees are eligible to use the nursing service, it is utilized primarily by the warehouse and production employees. The plant

TABLE 26

PAIR D – PLANTS 1 AND 2
REPORTED OCCUPATIONAL INJURY AND ILLNESS
1976-1978

Type of Injury or Illness	Number of Reported Cases 1976-1978	
	Plant 1	Plant 2
Laceration/Other Cuts	14	13
Back Strain	12	10
Contusion/Abrasion	8	7
Sprain/Other Strain	4	12
Foreign Body in Eye	4	4
Tendinitis	2	0
Fracture	2	3
Burn	1	1
Dermatitis	0	1

TABLE 27

PAIR D – PLANTS 1 AND 2
EMPLOYEE POPULATIONS

	1978		1977		1976	
	Plant 1	Plant 2	Plant 1	Plant 2	Plant 1	Plant 2
Production	240	258	247	289	255	300
Warehouse	103	N.A.	97	N.A.	110	N.A.
Administration	305	15	305	25	305	25
Total	648	273	649	304	670	315

N.A.: not applicable.

employees are 80% female and highly ethnic in origin (Greek, Portuguese, Italian, and Cuban). The plant is not unionized. Turnover is very low in the plant, about 2½% per year; it is higher in the warehouse, about 8% per year. Absenteeism averages 5.6% in the plant and 4.1% in the warehouse. The plant operates one shift, 5 days per week, except for the knitting operation, which runs on 3 shifts and has a total of 11 people on the second and third shifts. There have been no unscheduled shutdowns during the past several years; the plant does shut down for 2 weeks in July so that everyone can take a vacation.

At Plant 2, in addition to the production work force (which includes maintenance, housekeeping, knitting, pressing, and stiching employees, etc.), the plant has about 15 salaried and guaranteed employees, including mechanics, so that the work force has decreased from a total of about 315 in 1976 to the current level of about 270. The work force does increase somewhat during the summer when the plant hires temporary employees, typically students, to work during their vacations. Otherwise, the work force is extremely stable with a very low turnover (2%) and a low absenteeism rate (2%). The work force is primarily (80%) female, highly ethnic (Portuguese), and the average age is somewhat older than at Plant 1. It is believed that these factors may account for the low turnover and absenteeism rates. Except for the knitting area which operates on 3 shifts, all the other operations are carried out only on the first shift. Note that compared with Plant 1, this plant does not have a large warehouse operation, corporate work force, or company store. The plant shuts down for 2 weeks in July and lately has been shutting down for the Christmas week as well. The plant is not unionized.

OCCUPATIONAL SAFETY AND HEALTH PROGRAMS

Management Attitudes Toward Occupational Safety and Health

Administratively, the plant nurse reports to the personnel manager who reports to the corporate director of industrial relations. The personnel manager felt that the major contributions of the plant nurse were the following:

- Counseling — A major portion of the plant nurse's time was spent in what might be called counseling activities for problems which were not strictly related to occupational health. The plant nurse was considered to be an excellent sounding board and counselor. In addition to other employee oriented programs, including a generous compensation plan, it was felt that the plant nurse's counseling role was an important factor in maintaining a high level of employee morale. Counseling activities covered wide range of topics including family health, personal hygiene, breast cancer and self-examination, pregnancy and abortion, and marital and emotional problems. The plant nurse also served as a valuable resource for training first aiders and arranging services such as immunizations.
- Paperwork — The plant nurse handled a lot of required paperwork, including workers' compensation reports, long-term disability reports, pregnancy leaves, preparation of medical histories, and monthly continuation of work forms for pregnant women. The personnel manager estimated that since his department consisted only of himself and his secretary, he would have to hire another person to handle this paperwork if the plant nurse was unavailable. Such a person might be salaried at $12,000, instead of $16,000 for the plant nurse.

- Control of Absenteeism — The personnel manager believed that having the plant nurse familiar with plant situations and job requirements enabled employees to return to work sooner than would otherwise occur, at least in cases of minor health problems.

  With regard to plant policy, the personnel director indicated that there was an "open door" with respect to employees visiting the nurse. He felt that this availability was not abused, partly because of the nature of the work force, many of whom are rather self-reliant and tend to keep problems to themselves; and because most of the jobs are incentive-rated and the employees therefore do not wish to waste time. On the other hand, attributes such as self-reliance or incentive compensation could interfere with the effective functioning of a plant nurse if they led to underutilization of the service.

  The corporate director of industrial relations pointed out that the main criterion for whether or not there was a nurse at the company's plants, was the size of the work force. Thus, the company's two larger plants had nurses, while the two smaller ones did not. He also pointed out that it was important to have the right individual in the position: "the individual makes the job." The right individual could assist in fostering good will among the employees, could help in recognizing communications or personnel problems, and could be important in promoting a good safety program. He did not feel that proximity to a local hospital should be a factor in deciding whether or not to hire an occupational nurse.

At Plant 2 the plant manager felt that his plant did not need a nurse because:

- It was 5 minutes away from an ambulatory clinic where there was good service at a very reasonable price.
- He felt that even a nurse might not recognize a potential serious problem, and it was safer to have a physician see the employee.
- The cost of utilizing the outside clinic was not much greater than having an in-house nurse.
- The plant had first aiders on each shift.

He pointed out that some time ago the former plant owner did have a plant nurse, but she spent most of her time on secretarial work. He admitted that she was not the right kind of person to be a plant nurse and that a different nurse might be more effective. He added that the hospital emergency room did not provide the timely and quality service that was provided by the clinic currently utilized by the plant.

Program Facilities and Equipment

At Plant 1 the health facility occupies approximately 500 square feet and consists of a small waiting room, the nurse's office, 2 examination rooms, 2 lavatories, and a storage room. The facility was equipped with emergency respiratory kits. The plant does not have major medical equipment such as spirometers or X-ray machines. The estimated annual costs for facilities and equipment include $2,600 for allocated space costs, $900 for supplies, $160 for the employer's share of influenza vaccination costs, and $200 for miscellaneous costs such as seminars.

At Plant 2 the first aid room is small, about 100 square feet, and is furnished with basic first aid materials, a sink, a bed, and a small emergency oxygen bottle. The personnel manager estimated that the plant spent $500 per year for first aid supplies and about $100 per year for related courses and books. Allocated space is estimated to cost about $600.

Program Description and Personnel

A registered nurse has been employed by Plant 1 for 17 years. She has not had any formal training in occupational health; however, she had taken several seminars sponsored by the local Occupational Health Nurses' Association. Prior to becoming an occupational nurse, she was with a general hospital. She pointed out that acting as a plant nurse was considerably different from hospital nursing because a major part of her time was spent in counseling activities. She estimated that out of 35 hours per week, her time might be allocated into 5 general categories, as shown in Table 28. The nurse received an annual salary of $16,140 plus fringe benefits valued at 30% of the base salary or $4,842 for a total cost of $20,982. The cost of physician services was estimated to be $40 per hour x 2 hours per week x 50 weeks = $4,000.

TABLE 28

PAIR D – PLANT 1
ALLOCATION OF NURSING ACTIVITIES

Activity	Hours/Week	% of Time
Assisting with Preplacement Physical Exminations	10	29
Paperwork, Insurance Forms, etc.	2	6
Minor Injuries, Illnesses	12	34
Counseling	5*	14
Referral and Follow-Up on Occupational and Nonoccupational Health Problems	4	11
Safety Tours and Accident Investigations	2	6
Total	35	100%

*Other activities include informal counseling.

A local general practitioner visits Plant 1 every Tuesday morning for 2 to 3 hours. He has been associated with the plant for about 10 years. He has conducted preplacement physical examinations, and reviewed workers' compensation claims and long-term illness cases. He was not considered the plant medical officer, however, because he did not get involved with issues such as plant safety or industrial hygiene. Frequently, he would provide some care for nonoccupational health problems while visiting the plant.

Additional plant personnel who contribute to occupational safety and health programs include the plant personnel manager who has been trained in basic first aid and cardiopulmonary resuscitation, and 15 other employees who have recently received first aid training. Plans have been made for quarterly first aid training programs for employees.

Plant 2 does not have a nurse. First aid is provided by the personnel manager or by one of some dozen employees who have had first aid training. Two employees (the personnel manager and the quality control manager) also have training in cardiopulmonary resuscitation. When an accident occurs, the employee's supervisor is immediately notified and then the employee is sent to the first aid room. Typically, a forelady who is located near the first aid room will attend to the employee; in her absence, someone else with first aid training assumes the responsibility. A decision is then made on whether the employee should be seen by a physician or sent to the emergency room. This procedure is always followed in the case of severe bleeding, a deep cut, a needle accident, etc. The first choice is to send the employee to a local ambulatory clinic. This is a small clinic which specializes in occupational cases and where it is said that workers receive excellent service. An employee may be taken there, be seen by the physician, and come back to the plant within ½ to 1 hour. The second choice is to send the patient to the emergency room at the local hospital. This alternative usually takes much longer and the cost is higher. It was estimated that the personnel manager spends about ½ of her time on administrative matters which could be handled by a plant nurse. These include various injury reports, insurance forms, and OSHA reports.

Little asistance in occupational health is provided to either plant from outside sources, except for bimonthly visits from the loss control department of the company's workers' compensation insurance carrier. The nurse at Plant 1 visits Plant 2 annually to give influenza immunizations.

Health Promotion and Disease Prevention

As part of the physical examination, the nurse collects blood for a Hinton (VD) test, a Mantoux (TB) test, takes a urine sample, checks on tetanus immunization, and takes a medical history. She estimated that this procedure (which otherwise would have to be performed by a physician or an outside nurse) takes about 20 minutes per employee. In 1978, 244 employees were examined requiring about 81 hours of the plant nurse's time. She mentioned that the results of these examinations had detected some cases of diabetes and tuberculosis which were referred to the local hospital.

The nurse has conducted a number of clinics, such as hypertension screening, and influenza and tetanus immunizations. Since these services were provided at the plant, employees were saved the time of being away from the plant. More importantly, employees might not seek or receive such preventive care outside of the plant. Employees would not get paid when they miss work for this type of physician visit, so there would be no direct salary loss to the plant (except for the possibility of lost production). On the other hand, this type of visit would result in lost wages for the employees. Additional activities related to health promotion and disease prevention included family health counseling. The nurse has developed contacts with local service agencies to which she can refer employees. She also is a member of the plant safety committee, and participates in tours and meetings 3 times monthly.

At Plant 2 the personnel manager chairs the plant safety committee. She has conducted monthly plant tours and supervises accident investigations. Preplacement physical examinations have

been conducted at the local ambulatory clinic. They included a brief history, measurement of vital signs, urinalysis, but no blood work. Apparently, the plant did some considerable shopping around and got a very reasonable fee of $15 per examination. In 1978, about 20 examinations were conducted.

Occupational Injury and Illness

The nurse felt that occupational health-related lost time and associated costs were reduced by her surveillance of those situations where employees report problems. In many cases, for example, she would arrange to have the employees seen by the physician on his Tuesday morning visit, rather than have them go to an outside physician. Similarly, when there was an injury, she might first request that an X-ray be taken and, if there was no fracture, have the person go back to work, rather than be seen by another physician. She estimated that this situation might occur in approximately two-thirds of the 64 cases during 1978 when employees were seen by the physician. In some cases, employees are sent to the emergency room for reassurance rather than medical necessity. This may include employees with English language barriers or other employees who are concerned about a particular health problem. For major occupational injuries, the nurse preferred to send employees directly to local specialists (e.g., radiologists or orthopedic surgeons) rather than to the nearby emergency room. If an employee was out on long-term disability, the nurse normally did not interact with the employee's physician unless she became concerned that the length of disability was excessive.

Table 29 summarizes the occupational injuries and illnesses which Plant 1 reported to OSHA from 1976-1978. Because the incidence rates vary by type of employment, we have detailed the experience for the plant, warehouse, and administrative personnel. These cases represent most of the cases where the employee was seen by a physician (normally the "plant physician" referred to above), or, specifically, a radiologist in the case of a suspected fracture. Cases for which first aid was provided by the plant nurse, or where the plant nurse felt, on the basis of her professional judgment, that it was not necessary for the employee to be seen by a physician, are therefore not included in this summary. These cases reported to OSHA typically involved such injuries as lower back strains, lacerations, and contusions.

As shown in Table 29, the incidence rates varied from year to year, and between employment categories. The highest reported incidence rate was for warehouse employees, which averaged 10.4 cases per 100 employees per year during the 1976-1978 period. Plant employees averaged 6.4 cases per 100 employees per year, and administrative employees averaged only 0.7 cases per 100 employees per year. Because of these differences in incidence rates, only the plant experience should be utilized for comparison with the counterpart control (non-nurse) plant. Of the 6.4 cases per 100 employees per year in the plant, about half resulted in days away from work, and 25% resulted in absences of 6 or more days' duration. Days away from work averaged 82 days per 100 employees per year over the 3 years.

The plant nurse kept a record of the number and type of visits that she received. Approximately 800 visits out of a total of 5,100 visits per year were associated with occupational problems (these did not include the "OSHA-reportable" cases). It is clear that the nurse treated a significant number of occupationally related injuries and other problems which, had she not been present, may have necessitated a physician visit.

TABLE 29

PAIR D – PLANT 1
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

		Personnel	Total	Cases With Days Absent	Cases With >6 Days Absent	Days Away From Work	Average Days/ Lost-Time Case
1978	Plant	240	4.2	2.5	1.7	44	18
	Warehouse	103	11.7	7.8	2.9	75.7	10
	Administration	305	1.3	1.0	0.3	13.1	13
	Total	648	4.0	2.7	1.2	34.6	13
1977	Plant	247	7.3	4.0	1.2	121	30
	Warehouse	97	14.4	6.2	3.1	111	18
	Administration	305	0.3	0	0	0	0
	Total	649	5.1	2.5	0.9	62.9	25.5
1976	Plant	255	7.5	3.2	3.1	82	26
	Warehouse	110	5.5	3.6	0.9	11	3
	Administration	305	0.3	0.3	0	1.6	5
	Total	670	3.9	1.9	0.9	34	17
Average 1976-1978							
	Plant	247	6.4	3.2	1.6	82	25
	Warehouse	103	10.4	5.8	2.2	66	10
	Administration	305	0.7	0.4	0.1	5	9
	Total	655	4.3	2.3	1.0	44	18.5

Table 30 summarizes the occupational injuries and illnesses which Plant 2 reported to OSHA from 1976-1978. These apparently included most of the cases which were sent to the ambulatory clinic, the hospital emergency room, or other physicians. In 1978, there were 35 cases which required outside medical attention, of which 15 were determined to be "OSHA reportable," and 20 were categorized as "first aid" even though they were attended by a physician. Presumably, the majority of these first aid cases would not have resulted in physician or emergency room visits if there had been a plant nurse to handle the problem. For "reportable" cases, there were an average of 17 per year which results in a rate of 6 cases per 100 employees. The rate for cases involving days away from work was 2.7 per 100 employees, of which 0.8 cases per 100 employees involved 6 or more days of absence.

For workers' compensation insurance, the premium rates for Plant 2 are the same as those for Plant 1 because of a corporate rating system. Therefore, the plant pair cannot be evaluated in terms of premiums paid or calculated premium rates.

Nonoccupational Injury and Illness

The majority of the nurse's clinical activities are associated with nonoccupational health problems. In an average year, she receives over 4,300 nonoccupational vists, or about 85% of the total volume of visits. These include visits for minor ailments such as colds and allergies, stomach upsets, headaches, and the like. The average production employee, therefore, makes slightly over 2 occupationally related visits per year, and about 12 nonoccupationally related visits per year to the nurse. Over 90% of the visits to the nurse are employees in the plant and warehouse. The nurse attributed this to the location of her office on the plant floor. She did not believe that employees used the nursing service as an excuse for malingering. In fact, she remarked that employees were reluctant to leave work for minor problems. Again, this may relate to the nature of the piecework or incentive system. On the other hand, she does provide a useful service because the local outpatient clinic is open only in the mornings and employees would lose considerable amounts of work time if they did not have in-plant nursing services. The nurse also schedules in-plant visits with the plant doctor for nonoccupational health problems and also provides services at the request of the employee's physician, such as removal of sutures or periodic inoculations.

Plant 2 does not provide any services related to nonoccupational injury and illness except for an occasional aspirin or band-aid. The personnel manager reportedly does a certain amount of counseling which, in fact, is usually assistance with the administrative aspects of insurance claims. She estimated that 1 week per month was spent on related paperwork including completion of forms required for long-term disability, life insurance, and medical insurance.

Both plants have master medical insurance programs which have premiums calculated on the basis of community experience rather than plant experience. Although there has been little long-term illness on the part of employees, the nurse believes that their program is heavily utilized by employee dependents.

DISCUSSION

Although it may not be fully realistic to describe a typical daily case load, a review of a random day is illustrative of the variety of problems which are treated by the plant nurse. Of the 24 cases seen on the selected day, most were minor nonoccupational cuts and colds. She also treated 3 nonoccupational cases including blood pressure screening for a known hypertensive, treatment

TABLE 30

PAIR D – PLANT 2
SUMMARY OF INJURY AND ILLNESS EXPERIENCE
(Rate per 100 Employees)

	Personnel	Total	First Aid	Cases With Days Absent	Case With >6 Days Absent	Days Away From Work	Average Days/ Lost-Time Case
1978	258	13.6	7.8	3.9	0.8	38	10
1977	289	10.7	4.5	3.5	1.4	25	6
1976	300	7	1.0*	0.7	0.3	4	0.6
Average 1976-1978	282	10	4.4	2.7	0.8	23	5.5

*There was a change in personnel manager after 1976, which may have resulted in a revised policy for reporting first aid cases.

for weekend injury, and treatment for a jogging injury. The latter case was eventually sent for X-rays and found to have a fracture. There was a more severe occupational case, a contusion of a finger, which the nurse treated. It was her opinion that a first aider would have sent that case to the hospital for an X-ray which, in her professional judgment, was not warranted. These cases demonstrate either direct or indirect savings for the plant by providing in-plant nursing services. Even though this plant does not have any severe occupational hazards, the nurse has a positive influence on health problems. Improvements in the program could be made by utilizing injury and illness costs as an indicator of program effectiveness. Unfortunately, it appears that the major cost impact of occupational injury is a few long-term cases which incur substantial costs for compensation of lost wages. These cases, particularly back injuries, are difficult to prevent, diagnose, and rehabilitate.

Plant 2 benefits from the services of a nearby ambulatory clinic which handles their cases of occupational injury and illness. Little time is wasted when workers are sent to the clinic and the fees for service appear to be extremely favorable. The presence of such a convenient and economical relationship is probably the most crucial factor in support of their decision not to hire a plant nurse.

COMPARISON OF COSTS AND BENEFITS

PROGRAM COSTS

We have estimated that the direct cost of the nursing program in Plant 1 is about $25,000 per year, which is equivalent to $40 per employee, or $100 per hourly employee. A portion of these costs would have been incurred even if there were no nursing program: namely, the cost of a first aid program and the time for preparing reports for agencies such as OSHA (Table 31).

TABLE 31

PAIR D – PLANT 1
NURSING PROGRAM COSTS (1978)

Item	Cost
R.N. Salary	$16,140
Fringes @ 30%	4,842
Supplies	855
Flu Vaccine	158*
Miscellaneous (seminars)	200
Space – 430 sq. ft. @ $6	2,580
Total	$24,775

PAIR D – PLANT 2
FIRST AID PROGRAM COSTS (1978)

Item	Cost
Supplies	$ 500
Miscellaneous (course, books)	100
Space – 100 sq. ft. @ $6	600
Total	$1,200

PAIR D – PLANT 1
NURSING PROGRAM NET COSTS (1978)

Item	Cost
Direct Cost	$24,775
Less: First Aid Offset	1,595
Less: Reporting Offset	5,500
Net Cost	$17,680

*Estimate net of employees' contributions ($237).

Cost of First Aid

The first aid program at Plant 2 was estimated to cost $1,200 per year, which is equivalent to $4.65 per hourly employee. If the same cost were to apply to Plant 1, then the first aid program would have cost $4.65 x 343 hourly employees = $1,595. This estimate may be considered an offset against the actual cost of the nursing program.

Cost of Reporting Activities

The cost of the time associated with reporting activities can be estimated in several ways:

- About 35% of the plant nurse's time is associated with administrative activities, which presumably would have to be performed by someone else if there were no plant nurse. The cost of this time is estimated to be 35% x $20,982 (nurse's salary, plus 30% fringe benefits) = $7,344.
- Assuming that a lower-salaried person could perform these functions and that it would also require 35% of that person's time, then the cost would be 35% x $12,000 x 130% = $5,460, assuming an annual salary of $12,000 and fringe benefits of 30%.
- At Plant 2 it was estimated that about one-half of the personnel manager's time was spent on activities that could otherwise be performed by the plant nurse, and that the allocated costs were $6,750 per year. The cost of the administrative services provided by the nurse is therefore estimated to be in the range of $5,400-$7,350 per year. To be conservative, we estimated the offsetting cost of this component as the lower end of the range, $5,500.

Net Program Costs

The net cost of the nursing program is therefore estimated to be the direct costs ($24,780) less the offsetting costs of first aid ($1,600) and reporting ($5,500) for a net cost of $17,700. This net cost is equivalent to about $52 per hourly employee per year.

PROGRAM BENEFITS TO THE EMPLOYER

Direct Benefits to the Employer

The direct benefits to the employer which accrue from having an occupational nursing program are quantitative financial benefits. Three distinct areas of benefit have been identified.

Physical Examination Costs

The plant nurse does much of the preliminary paperwork and clinical testing required for preplacement physical examinations. Assuming that this function saves the physician ¼ of an hour per examination, the annual savings in physician's fees are: 244 examinations x ¼ hour x $40/hour = $2,440. Plant 2, on the other hand, would probably not achieve significant savings in this area by having a plant nurse because they have established an extremely cost-effective arrangement with the local ambulatory clinic and also, because of low turnover, their need for such examinations is minimal. They should, however, consider conducting annual or other periodic physical examinations.

Insurance Costs

Table 32 presents a comparison of the two plants based upon the rate per 100 production employees for occupational injury or illness which incurred a visit to a physician or the hospital emergency room. For Plant 2, this rate includes cases which were described as "OSHA reportable" as well as cases which were "first aid" but were treated by a physician. For Plant 1, the OSHA Log does not distinguish between "first aid" and "reportable cases." The total case rate is lower (4 cases per 100 employees) in the plant with a nurse; however, there is little difference in the rate for cases with lost days.

TABLE 32

COMPARISON OF PAIR D – PLANTS 1 AND 2*

	Plant 1		Plant 2		Difference	
	Total Cases	Cases With Days Absent	Total Cases	Cases With Days Absent	Total Cases	Cases With Days Absent
1978	4.2	2.5	13.6	3.9	9.4	1.4
1977	7.3	4.0	10.7	3.5	3.4	(0.5)
1976	7.5	3.2	7.0	0.7	(0.5)	(2.5)
Average	6.4	3.2	10.4	2.7	4.0	(0.5)

*Cases per 100 production employees requiring medical attention.

If the 4 cases per 100 employees are a benefit due to the provision of in-plant nursing services rather than sending the employee out for medical care, the associated cost savings include $55 per case (based upon typical medical charges for workers' compensation) and an estimated loss of 2 hours per case at a rate of $5 per hour. The total savings, therefore, is $260 per 100 production employees or for an average of 247 plant employees at Plant 1, the total would be $642, which might result in a future impact on compensation premiums of about $1,000 to $1,600.

From the point of view of managers at Plant 2, in 1978 this plant recorded 35 cases in the OSHA Log of which 20 were listed as "first aid" even though they were treated by a physician. If a plant nurse treated all of these cases, an estimated savings of $55 x 20 cases = $1,100 in medical costs might result with a potential impact on compensation premiums of $1,700 to $2,800. Assuming that the OSHA Log is an accurate approximation of the number of cases requiring medical attention, the demand at Plant 1 and Plant 2 is extremely low.

Another approach is to evaluate the current demand for nursing services at Plant 1, where on an annual basis 800 occupational cases and 4,300 nonoccupational cases are treated by the plant nurse. In this case, assuming that 10% of the occupational cases might require outside medical attention if the nurse was not present, the result is a savings of $55 x 80 = $4,400 which could result in a savings of $7,000 to $11,000 on future workers' compensation premium costs.

Lost Production Time

The 80 occupational cases which may have been prevented by occupational nursing activities would have resulted in a considerable amount of time away from work for the employee. If one assumes a duration of 2 hours for a visit to a physician or the emergency room, this results in 160 hours of lost time and, at a base hourly rate of $5.00, this represents a loss of about $800 plus any related fringe benefits. Since the employee is paid for this time while away from work, the loss is incurred by the employer.

Indirect Benefits to the Employer

Administrative personnel at Plant 1 place as much, if not more, value on the intangible benefits of a plant nurse program as they do on the tangible benefits. They see the availability of a plant nurse as a significant element in an employee benefits program which, in turn, makes the plant a more desirable place in which to work. The availability of the plant nurse:

- Shows management's interest and commitment to the health care-related problems of the employee;
- Ensures a professional medical person is available in case of injury or accident, and is available to take an active part in the safety program;
- Helps employees in regard to minor nonoccupationally as well as occupationally related injuries or health problems; and
- Provides a counseling service which can assist in having more satisfied and well-adjusted employees.

Because they feel that the net cost of a nursing program is relatively low, the intangible benefits are deemed to be sufficient justification for the program.

PROGRAM BENEFITS TO THE EMPLOYEE

Direct Benefits to the Employee

The plant nurse treats about 4,300 nonoccupational cases each year. Although most of these cases are minor, some would require a physician or hospital emergency room visit if the nurse was not available. Assuming that between 1% and 10% of the cases would require such treatment at a minimum of $20 per visit, this would result in a cost of almost $900 to $9,000 as well as lost wages if the visits resulted in time away from work. At $5 per hour and 2 hours per visit, this would be a loss of $430 to $4,300 plus any cost fringe benefits. It is likely that most of the medical care costs would not be covered by insurance because of the quarterly deductible.

Indirect Benefits to the Employee

Potential benefits to employees include improved personal health. It is difficult to ascribe an economic benefit to such events as early detection of hypertension. On the one hand, it could be argued that the employee will eventually receive treatment so that early detection provides no additional benefit. On the other hand, many employees do not have access to the medical system and chronic conditions may progress to life-threatening stages before medical treatment is received.

DISCUSSION

The Plant 1 nursing program is estimated to have an annual net cost of about $18,000. Associated with this cost are both direct and indirect benefits which accrue to both the employer and the employee. The values of some direct benefits have been estimated:

• Savings on physical examinations.	$2,440
• Savings based upon OSHA Log comparisons.	$1,000 to $1,600
• Plant 2 potential savings from reducing outside first aid.	$1,700 to $2,800
• Plant 1 reduced outside medical treatment of first aid cases.	$7,000-$11,000
• Savings on wages paid without production.	$800
• Saved wages for employees for nonoccupational conditions.	$430-$4,300
• Savings on employee medical costs.	$900-$9,000

Note that these benefits are not all additive. Also, indirect benefits have been identified and, although information is not available to make quantitative estimates, they should be considered for a complete assessment of benefits.

The comparison of these two plants is difficult because of size differences which are due to a large population of warehouse and administrative employees at Plant 1. This difference was recognized at the outset of the study and was accepted because of the desire to include a pair of plants which belonged to the same corporation. It is now clear that the selection was not appropriate. Nevertheless, several general conclusions are evident. First, the clothing industry appears to be relatively safe in terms of occupational injury and illness. Second, a major service which the plant nurse provides is care for nonoccupational injury and illness where benefits to the employer are related to reduced absenteeism and benefits to the employee include reduced medical costs and reduced wages lost for medical visits.

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