

R0728

PB90180217



## TRENDS IN HEALTH CARE IN INDUSTRIAL PLANTS

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| <b>REPORT DOCUMENTATION PAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 1. REPORT NO. | 2.                               | PB90-180217                                    |                        |
| 4. Title and Subtitle Trends in Health Care in Industrial Plants                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |               |                                  | 5. Report Date<br>00/00/00                     |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |               |                                  | 6.                                             |                        |
| 7. Author(s) Sieber, W. K., Jr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |               |                                  | 8. Performing Organization Rept. No.           |                        |
| 9. Performing Organization Name and Address Division of Surveillance, Hazard Evaluations and Field Studies, NIOSH, Cincinnati                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |               |                                  | 10. Project/Task/Work Unit No.                 |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |               |                                  | 11. Contract (C) or Grant(G) No.<br>(C)<br>(G) |                        |
| 12. Sponsoring Organization Name and Address                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |               |                                  | 13. Type of Report & Period Covered            |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |               |                                  | 14.                                            |                        |
| 15. Supplementary Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |               |                                  |                                                |                        |
| <p>16. Abstract (Limit: 200 words) Cluster analysis was used to investigate trends in the provision of medical care in industrial facilities over the years. The analysis was conducted at group facilities which employed in/house physicians. Separate analyses were performed using responses from each of two occupational surveys conducted 10 years apart. The clusters resulting from each survey were then compared for differences in physician hours per employee per week and occupational injury rates per 1000 employees. Industries with high injury rates in each survey were identified. Each survey revealed four distinct clusters. As the mean number of employees increased in each cluster in each survey, the number of physician hours per week per 10,000 employees decreased. Clusters in the National Occupational Hazard Survey (NOES) survey included facilities with more employees. The mean number of physician hours per week per 10,000 employees decreased most between clusters 1 and 2 in each survey. The overall percentages of unionized facilities were similar in both surveys. A higher percentage of facilities in the NOES had arrangements with outside physicians or clinics for medical care. The percentage of facilities in the NOES with arrangements with outside physicians or clinics for medical care decreased across clusters. Mean rates of reported occupational injuries per year per 1,000 employees decreased in each cluster and in each survey. Facilities in cluster number 1 had the highest rates of occupational injuries in each survey, particularly those in the Standard Industrial Classification 35 which includes the manufacture of machinery, except electrical.</p> |  |               |                                  |                                                |                        |
| 17. Document Analysis a. Descriptors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |               |                                  |                                                |                        |
| b. Identifiers/Open-Ended Terms NIOSH-Publication, NIOSH-Author, Occupational-health-programs, Industrial-health-programs, Worker-health, Health-care-personnel, Analytical-methods, Industrial-hazards, Industrial-medicine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |               |                                  |                                                |                        |
| c. COSATI Field/Group                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |               |                                  |                                                |                        |
| 18. Availability Statement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |               | 19. Security Class (This Report) |                                                | 21. No. of Pages<br>16 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |               | 22. Security Class (This Page)   |                                                | 22. Price<br>A03       |



### The Problem

Trends in the provision of medical care in industrial plants have appeared over the years. To investigate such trends, cluster analysis was used to group plants which employed in-house physicians. Separate analyses were performed using responses from each of two occupational surveys conducted ten years apart. The clusters resulting from each survey were then compared for differences in physician hours per employee per week and occupational injury rates per 1,000 employees.



### Cluster Analysis in an Occupational Survey

Clustering places objects into groups suggested by the data. In this application, observations in each of two surveys separated in time are grouped. The resulting clusters for each survey reflect conditions at the time of the survey, and may be used for comparative purposes across surveys as in a longitudinal study. Associations found in each cluster may also be studied since variation between observations in a cluster is reduced from that in the entire survey. Clustering used here is not meant to provide formal statistical tests or modeling procedures. It is used to combine data into useful groups for further analysis over time.

## Materials and Methods

Plants which employed a physician in-house according to either the 1972-1974 National Occupational Hazard Survey (NOHS) or 1981-1983 National Occupational Exposure Survey (NOES) were grouped. Separate analyses were done for each survey. Variables considered in each survey were total number of employees and number of physician hours per 10,000 employees per week.

Characteristics of clusters in each survey were compared. The rates of reported occupational injuries in clusters were compared across surveys. Industries with high injury rates in each survey were identified.

The method of k-means was used to group plants. The method is based on Euclidean distances computed from one or more qualitative variables using the formula:  $\sqrt{(x_i - x_j)^2 + (y_i - y_j)^2 + \dots}$ . Clusters are formed from groups of observations as the method seeks to minimize the within group variation (or sum of squares), while maximizing the between group variation. The process can be likened to an analysis of variance where groupings are unknown and the largest F value is sought by reassigning members to each group.

## Results

1. 4 distinct clusters were found in each survey.
2. As the mean number of employees increased in each cluster in each survey, the number of physician hours per week per 10,000 employees decreased.
3. Clusters in the NOES survey included plants with more employees.
4. The mean number of physician hours per week per 10,000 employees decreases most between clusters 1 and 2 in each survey.

## Results

1. Overall percentages of unionized plants are similar in both surveys.
2. A higher percentage of plants in the NOES had arrangements with outside physicians or clinics for medical care.
3. The percentage of plants in the NOES with arrangements with outside physicians or clinics for medical care decreased across clusters.
4. Mean rates of reported occupational injuries per year per 1,000 employees decreased in each cluster and in each survey.
5. Plants in cluster #1 had the highest rates of occupational injuries in each survey, particularly those in Standard Industrial Classification (SIC) 35 (Manufacture of Machinery, Except Electrical).

### Discussion

1. A trend toward arrangements for medical care from sources other than in-house physicians (such as from clinics or outside physicians) appears in the NOES. Smaller plants (cluster 1) have such arrangements.
2. Individual industries (such as SIC 35) have high occupational injury rates in each survey. Surveillance of occupational injuries might be instituted in such an industry. This clustering technique grouped such industries together for consideration.

### Conclusions

1. Cluster analysis can be used to group plants by specific characteristics.
2. Comparison of clusters across surveys can be used to determine industries or facilities with specific characteristics for surveillance purposes.

### Sources of Data

1972-1974 National Occupational Hazard Survey (NOHS)  
4,636 facilities surveyed

1981-1983 National Occupational Exposure Survey (NOES)  
4,490 facilities surveyed

Both surveys were cross sectional surveys of industrial plants.

Each sample consisted of a probability sample of business facilities selected under a multi-stage sampling plan considering geographical location, industry type, and number of employees per facility.

Each survey consisted of a management questionnaire and a walk-through inspection of the manufacturing areas of the facility.

Description of Clusters

| <u>NOHS</u>    |                             |                                      |                                                                                 |
|----------------|-----------------------------|--------------------------------------|---------------------------------------------------------------------------------|
| <u>Cluster</u> | <u>Number<br/>of Plants</u> | <u>Mean Number<br/>of Employees*</u> | <u>Mean Number of<br/>Physician Hours<br/>per Week per<br/>10,000 Employees</u> |
| 1              | 136                         | 656                                  | 307                                                                             |
| 2              | 29                          | 4436                                 | 142                                                                             |
| 3              | 6                           | 11102                                | 107                                                                             |
| 4              | 1                           | 26056                                | 138                                                                             |
| Total          | 172                         | 1806                                 | 271                                                                             |

| <u>NOES</u>    |                             |                                       |                                                                                 |
|----------------|-----------------------------|---------------------------------------|---------------------------------------------------------------------------------|
| <u>Cluster</u> | <u>Number<br/>of Plants</u> | <u>Mean Number<br/>of Employees**</u> | <u>Mean Number of<br/>Physician Hours<br/>per Week per<br/>10,000 Employees</u> |
| 1              | 222                         | 1300                                  | 369                                                                             |
| 2              | 74                          | 5370                                  | 127                                                                             |
| 3              | 13                          | 14161                                 | 83                                                                              |
| 4              | 2                           | 26631                                 | 33                                                                              |
| Total          | 311                         | 2969                                  | 297                                                                             |

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\* F = 644.282, P = .000  
 \*\* F = 758.964, P = .000

Description of Clusters

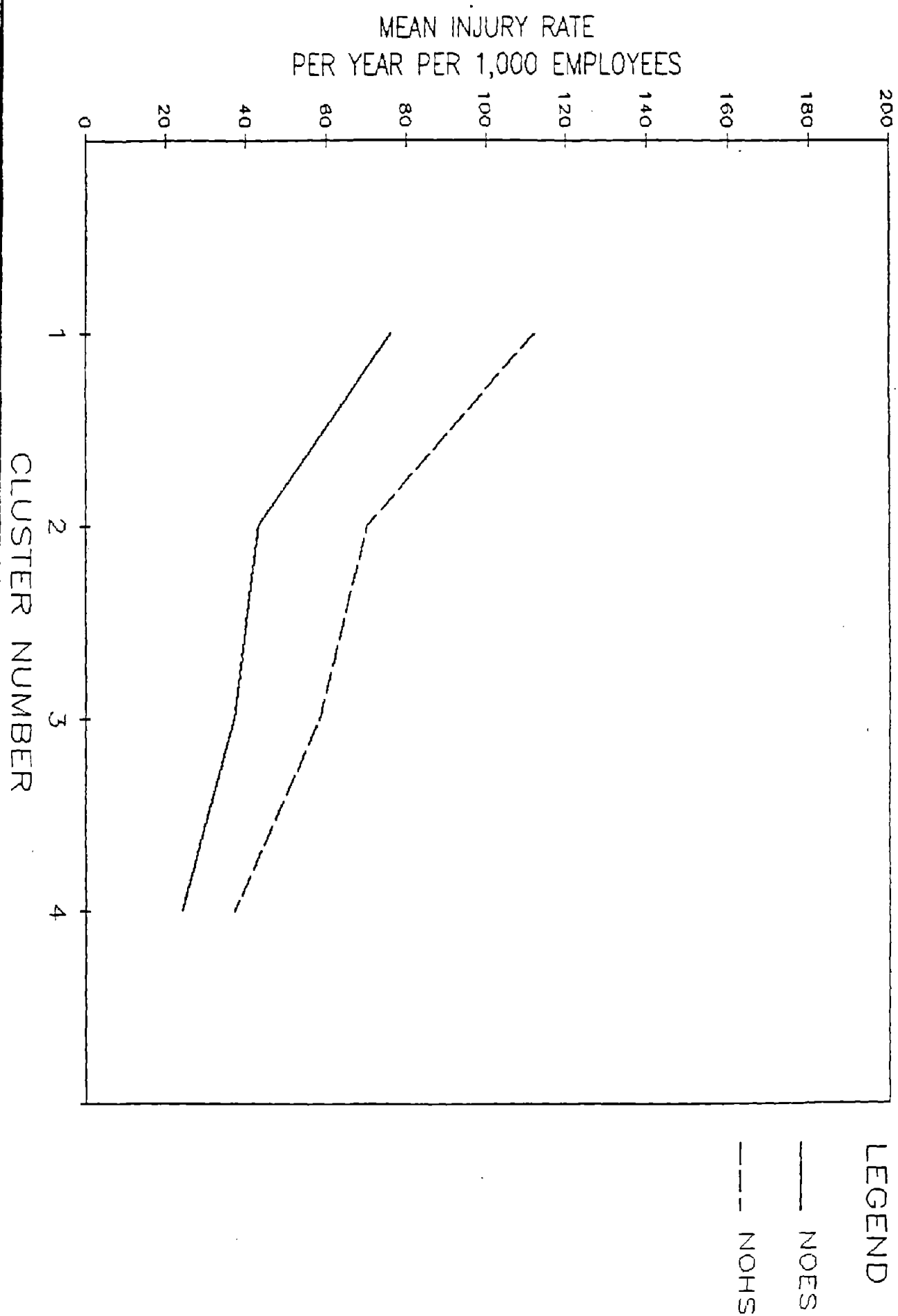
NOHS

| <u>Cluster</u> | <u>Number<br/>of Plants</u> | <u>Percent<br/>of Plants<br/>Unionized</u> | <u>Percent of Plants<br/>Having Arrangement<br/>with Outside<br/>Physician or Clinic<br/>for Medical Care</u> | <u>Mean Injury Rate<br/>per Year per<br/>1,000 Employees</u> |
|----------------|-----------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 1              | 136                         | 73.5                                       | 0                                                                                                             | 112                                                          |
| 2              | 29                          | 82.8                                       | 0                                                                                                             | 70                                                           |
| 3              | 6                           | 100.0                                      | 0                                                                                                             | 58                                                           |
| 4              | 1                           | 100.0                                      | 0                                                                                                             | 38                                                           |
| Total          | 172                         | 76.2                                       | 0                                                                                                             | 103                                                          |

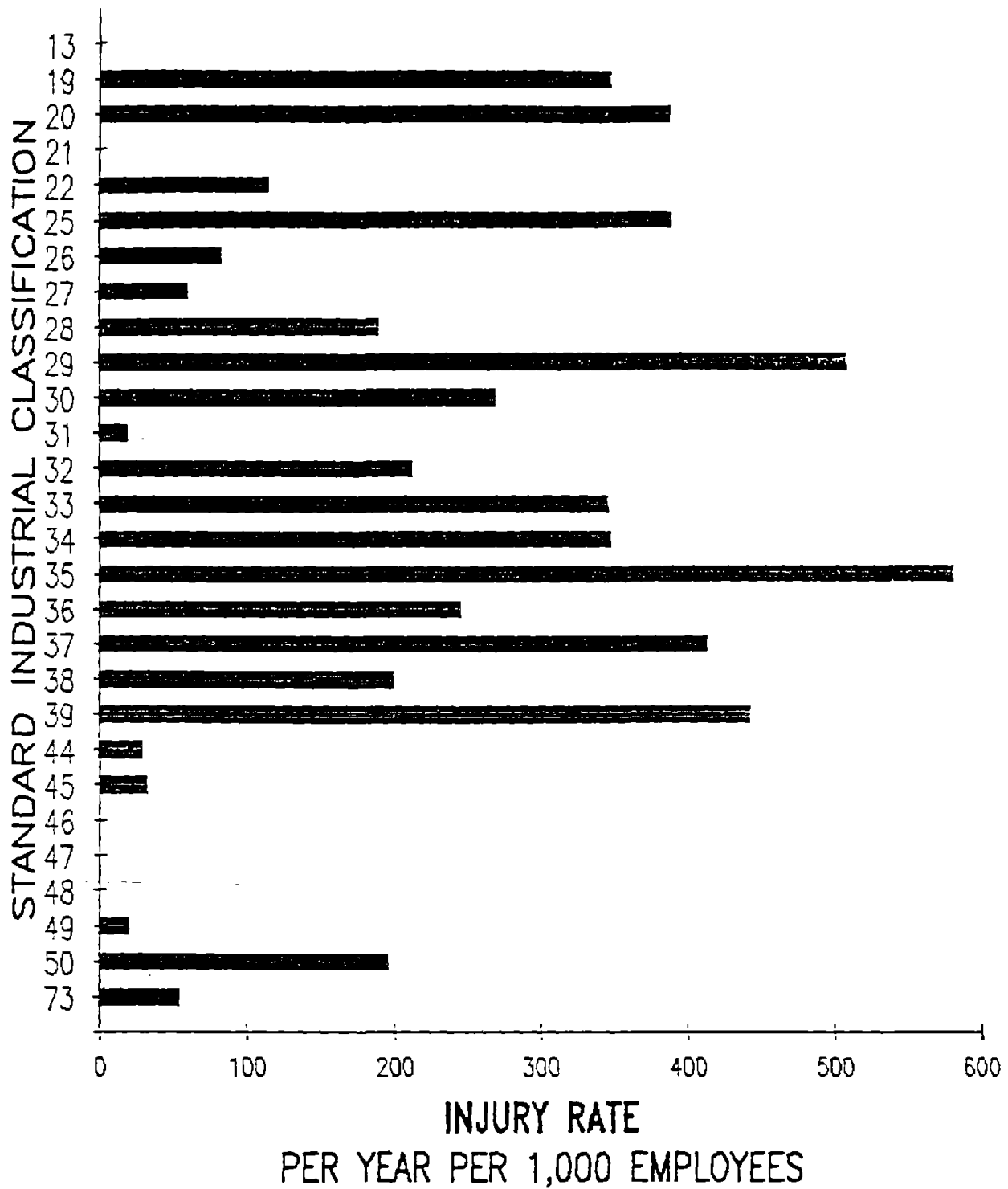
NOES

| <u>Cluster</u> | <u>Number<br/>of Plants</u> | <u>Percent<br/>of Plants<br/>Unionized</u> | <u>Percent of Plants<br/>Having Arrangement<br/>with Outside<br/>Physician or Clinic<br/>for Medical Care</u> | <u>Mean Injury Rate<br/>per Year per<br/>1,000 Employees</u> |
|----------------|-----------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 1              | 222                         | 78.4                                       | 52.3                                                                                                          | 76                                                           |
| 2              | 74                          | 78.4                                       | 33.8                                                                                                          | 43                                                           |
| 3              | 13                          | 84.6                                       | 23.1                                                                                                          | 37                                                           |
| 4              | 2                           | 50.0                                       | 0.0                                                                                                           | 24                                                           |
| Total          | 311                         | 78.5                                       | 46.3                                                                                                          | 66                                                           |

PLOT OF MEAN INJURY RATE BY CLUSTER NUMBER



PLOT OF INJURY RATE BY SIC CODE  
OF PLANTS IN CLUSTER # 1  
(NOHS 1972-1974)



# PLOT OF INJURY RATE BY SIC CODE OF PLANTS IN CLUSTER # 1 (NOES 1981-1983)

