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CARGILL POULTRY DIVISION
BUENA VISTA, GEORGIA

NIOSH INVESTIGATORS:
Thomas Hales, M.D.
Lawrence Fine, M.D., Dr.P.H.

I. SUMMARY

On May 22, 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) for technical assistance in evaluating cumulative trauma disorders (CTDs) among employees at the Cargill Poultry plant in Buena Vista, Georgia. After a walk-through survey on June 1, 1989, the evaluation was conducted on July 11-20, 1989. The evaluation addressed 1) the incidence rate and prevalence of upper extremity (UE) CTDs in this plant, 2) the implementation of administrative controls to prevent UE CTDs, and 3) the medical management of workers with UE CTDs.

For the one-year period 1/1/88 to 12/31/88, NIOSH investigators found a relatively high incidence rate of upper extremity (UE) CTDs among workers at the Cargill Poultry plant in Buena Vista, Georgia. There were 143 UE CTDs recorded on the OSHA 200 Logs during this time period. This plant's UE CTD incidence rate was 34.9 per 100 full-time workers (ftw) per year; this compares with a rate of 2.6 reported for the poultry dressing industry [rate ratio (RR)=13.4, 95% confidence interval (CI) 11.9, 15.9]. For these 143 OSHA Log UE CTD entries, the mean number of days off work was 0.5 (median <0.1), with 140 (98%) having no days off work. The mean number of days on restricted duty was 5.0 days (median = 2.5) with 45 (32%) having no restricted work days. The company has probably made a concerted effort to accurately record UE CTDs onto the OSHA 200 Logs over the past year.

One-hundred-and-twelve employees were selected for participation in the NIOSH survey based on job title. From the questionnaires and physical examinations performed on the 112 participating employees, a high prevalence of UE CTDs, particularly hand-wrist CTDs, was found among current employees. Fifty-three (47%) of the 112 had work-related UE CTDs during the past year determined by questionnaire. Thirty-five (31%) of the 112 participating workers had current work-related UE CTDs as determined by questionnaire and physical examination.

The questionnaire also elicited information about the implementation of potential administrative controls (sharp knives, training, and job rotation). Sharp cutting tools probably lower the level of force required to perform many job activities, thereby probably reducing the risk of acquiring an UE CTD. Sixteen percent of workers stated they received sharpened knives, and 14% of workers stated they received sharpened scissors 4 or more times per day. In general, employees reported that sharp knives and scissors are needed at least 4 times per day. Eighty-two percent of employees using a knife received training in how to properly cut the meat, and 51% received training on how to sharpen their knives. Five percent of all interviewed employees stated they received training on the early signs and symptoms of CTDs. Eighty percent of employees in high risk jobs are involved in a job rotation program, rotating, on the average, among 4 jobs per day, two days per week.

Of the 53 survey participants with reported work-related UE CTDs on questionnaires and physical examinations, 40 (76%) were evaluated by the plant nurse, of which 7 (14%) were referred to the plant physician for evaluation. For the remaining 13 employees, 8 (15%) stated that at some time during the course of their problem in the past year the foremen refused to allow employees to go to the first aid department for evaluation of CTD symptoms. The remaining 5 (10%) employees did not seek medical care.

The employee turnover at this plant is approximately 50% per year. This high rate of turnover suggests that survivor bias may be a substantial problem in our survey. "Survivors" are usually healthier (that is, lacking illness or injury that would interfere with work) than those who have left employment. This "healthy worker" or "survivor effect" is an inherent bias of this study's cross-sectional design, and may result in our underestimating the true prevalence of UE CTDs in this plant.

During the six months prior to NIOSH's evaluation, the company initiated several programs to curb CTD problems within this plant. After complete implementation of these programs, time will be needed to determine each program's effectiveness. At the time of this evaluation the company needed to: a) ergonomically evaluate all high exposure jobs identified on the OSHA 200 Logs (see Recommendations Section, VIII A 1); b) provide sharp knives and scissors to employees at least 4 times per day (see Discussion Section, VI C 1); c) implement the job rotation program among high and low exposure jobs on a daily basis (although caution must be used for two reasons: one, the effectiveness of a job rotation program has never been proven, and two, different jobs may appear to have different stressors but they may actually pose the same physical demands); d) use job rotation as a CTD prevention program rather than a form of treatment (see Discussion Section, VI C 2); e) improve implementation of the knife sharpening training program (see Discussion Section, VI C 3); f) improve access of symptomatic workers to the first aid department for nursing evaluation; g) refer employees with significant work-related UE CTDs for physician evaluation; h) improve access to restricted (light) duty jobs for employees with significant work-related CTDs; i) expand the number of restricted (light) duty jobs available at the plant; and j) include employees, foremen, and supervisors in the UE CTD education program emphasizing the need for early evaluation and treatment of CTD symptoms. These and other recommendations are outlined in this report.

On the basis of this evaluation, NIOSH investigators concluded an upper extremity CTD hazard existed at this plant. Recommendations to prevent and reduce the morbidity associated with current cases are included in this report.

KEY WORDS: SIC 2016 (Poultry Dressing Plants), ergonomics, cumulative trauma disorders, CTDs, RSI, carpal tunnel syndrome, tendonitis, tenosynovitis, force, repetition, knives, scissors.

II. INTRODUCTION

On May 22, 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) for technical assistance in evaluating cumulative trauma disorders (CTDs) among employees at the Cargill Poultry plant in Buena Vista, Georgia. The objectives of the evaluation were to:

- 1) Using the OSHA 200 Logs, a) determine the plant's incidence rate of upper extremity (UE) CTDs in 1988, and b) calculate the number of missed and restricted work days for employees with UE CTDs;
- 2) using standardized questionnaires and physical examinations designed to elicit UE CTD symptoms and signs on 112 plant employees selected by current job a) determine the prevalence of UE CTDs in this plant, and b) calculate the number of missed and restricted work days for employees with UE CTDs;
- 3) evaluate employee access to sharp knives and scissors;
- 4) evaluate the implementation of the company's job rotation program;
- 5) evaluate the company's training programs on cutting techniques, knife sharpening, and education on the early symptoms of CTDs;
- 6) evaluate employee access to nursing and physician evaluations for CTD symptoms.

After a walk-through survey on June 1, 1989, the evaluation was conducted on July 11-20, 1989.

III. BACKGROUND

A. Process Description

Cargill Poultry Division, Buena Vista, Georgia produces boneless chicken products for wholesale distribution. The plant operates two shifts: the first shift slaughters, eviscerates, dissects, debones, and packages chickens, while the second shift only dissects, debones and packages. Four-hundred-and-nine hourly employees work at the plant, the majority working in the deboning department. (Table 1) The deboning department is predominantly staffed by women (approximately 85%).

The slaughtering process involves suspending the chickens by their feet on an overhead chain conveyor, followed by an electric shock to stun the animals. A machine subsequently cuts the necks to exsanguinate the birds. The chain conveyor moves at a pre-determined speed while machines and workers positioned along the lines de-feather and eviscerate the animals. The carcasses are cooled to 45°F in a water bath for 45 minutes and placed on a supporting structure referred to as a "cone". The cones are fixed to a moving conveyor (lines) with workers positioned along these lines dissecting and deboning the meat from the carcass. The resulting meat is inspected, graded, and packaged for distribution. The workers performing the evisceration, dissection, and deboning are frequently equipped with knives and/or scissors, depending on the specific job task.

Overall, the plant processes approximately 67,200 chickens during two shifts. The line speeds vary by department: the slaughter department (receive, hang, and kill) operates at a rate of approximately 124 birds per minute, the evisceration department at approximately 62 birds per minute, and the deboning (dissect and debone) department at approximately 20 birds per minute. There are many jobs in this plant which are highly repetitive (job cycles less than 30 seconds).

IV. EVALUATION DESIGN AND METHODS

A. Incidence Rates

Upper extremity CTDs are a class of musculoskeletal disorders involving damage to the tendons, tendon sheaths, and the related bones, muscles, and nerves of the hands, wrists, elbows, shoulders, and neck. These disorders develop as a result of chronic exposure of a particular body part to repeated biomechanical stress, which, by cumulative effect, produce a debilitating physical condition. The biomechanical stress can include any of the following: repetition, force, vibration, extreme angles, or direct trauma. The common CTD diagnoses are listed in Appendix A.¹⁻⁴

Incidence rates for upper extremity (UE) CTDs were calculated for the whole plant, departments, and specific job titles using OSHA 200 logs for calendar year 1988. The total number of CTDs entered onto the OSHA 200 log was divided by the total number of employee hours worked for the whole plant, specific departments, and individual jobs for 1988. This type of incidence rate, using employee hours worked as the denominator, is used by the Bureau of Labor Statistics (BLS).⁵ Rate ratios (RR) with 95% 2-tailed confidence intervals were calculated for the plant using the CTD rate among the US poultry dressing plants in 1987 as the referent.⁶

OSHA 200 Logs provide a record of "OSHA - recordable occupational injuries", which include all work-related deaths and illness, and work-related injuries involving one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment other than first aid.⁷ OSHA log entries of CTDs are typically listed under the column 7f, "disorders associated with repeated trauma." All "7f" entries were reviewed for their appropriateness to be included as an UE CTD. All sprains, fractures, lacerations, and contusions were excluded from our analysis. In addition, conditions involving the back, chest wall, and lower extremities were excluded. Each entry could list one or more symptoms or diagnoses, and affect one or more joint areas.

B. Prevalence Study

1. Selection Criteria

Since the jobs selected for the NIOSH survey were predominately performed by women (118 of 122 employees), the men were excluded from the questionnaire and physical examination portion of this evaluation.

a) Lower Exposure Group

All production line departments employing hourly workers were observed during a walk-through survey. Three jobs (breast inspectors, thigh inspectors, and quality control inspectors) appeared to have lower exposure to repetitive and forceful hand-wrist motions than the other jobs within the plant. This impression was substantiated by the relatively low number of CTDs recorded onto the OSHA 200 Logs for these job titles. (Tables 2, 3) Day- and evening-shift female workers employed as breast, thigh, or quality control inspectors were invited to participate in NIOSH's survey as the lower exposure group (LEG).

b) Higher Exposure Group

Based on our observations and OSHA 200 Log data, one department (deboning) was selected for the survey because it had jobs with higher exposure to repetitive and forceful hand-wrist motions. Jobs within this department were selected based on:

- i) any job with an OSHA 200 Log incidence rate of >100 UE CTDs per 100 full time worker (ftw), or
- ii) any job with 16 or more employees performing the job, and an OSHA 200 Log incidence rate of >25 UE CTDs per 100 ftw.

Nine jobs fulfilled this selection criteria. Three of these 9 jobs (wing cut, thigh debone, and final cut) were being ergonomically evaluated by a consultant hired by OSHA to design feasible solutions to abate the ergonomic hazards. To avoid duplication of work, these three jobs were excluded from our selection criteria with the exception of thigh debone. We included thigh debone to confirm the OSHA 200 Log information, and chose thigh debone because it had the highest incidence rate. Thus, our final job selection for the higher exposure group (HEG) consisted of the following 7 jobs: breast trim, thigh debone, leg cut/disjoint, tender cut, knuckle cut, breast pull, thigh fat trim. Day- and evening-shift female workers employed in the above 7 jobs were invited to participate in NIOSH's study.

2. Period Prevalence

Period prevalences were calculated for the 12 months prior to NIOSH's survey from standardized questionnaires administered to current employees. The questionnaires elicited demographic information; work history information, including months/years on the job; and prior health history information including chronic diseases and prior upper extremity injuries. The remainder of the questions addressed upper extremity pain or discomfort experienced within the previous year. If a participant had experienced difficulty in one or more parts of the upper extremity, more detailed information was sought regarding the problem including location, duration, onset, aggravating factors, and treatment.

A case of UE CTD was defined as one or more symptoms (pain, numbness, tingling, aching, stiffness, or burning) in one of the 5 upper extremity joint areas (neck, shoulder, elbow, wrist, or hand) which satisfied all of the following criteria:

- a. No previous accident or sudden trauma to the joint,
- b. Symptoms began after employment at the plant,
- c. Symptoms occurred within the past year,
- d. Symptoms lasted more than 8 hours, and
- e. Symptoms occurred 4 or more times in the previous year.

To account for age differences between the HEG and LEG, the exposure groups were stratified by age (35 years and younger, and greater than 35 years). This age was based on the age distribution of participants. Because of the age stratification, comparisons of all UE joint area CTDs one-year period prevalence between the HEG and LEG are reported as both crude and summary relative risks (RR) with 95% confidence intervals (CI).⁸ In addition, to control for the length of time spent on the employee's current job, the exposure groups were stratified by time on the current job (6 months or less, and greater than 6 months). This cutoff point was chosen based on the length of time an UE CTD can develop.

3. Point Prevalence

All employees completing the questionnaire described above had a physical examination performed by a physician trained in internal and occupational medicine. This physician was blinded as to the questionnaire results and the HEG/LEG status. The examinations were limited to evaluation of the neck and upper extremities, and designed to detect upper extremity CTDs. The examinations included inspection, palpation, range of motion (active, passive and resisted), and various maneuvers. Appendix B lists the disorders and their diagnostic criteria. An upper extremity CTD case was defined as symptoms that satisfied the questionnaire case definition (criteria listed in the preceding section) and the presence of physical examination findings (criteria listed in appendix B) affecting the same specific symptomatic joint area.

Stratifying by age and length of time on the current job, comparisons of all upper extremity joint area CTDs point prevalence between the HEG and LEG are reported as crude and summary relative risks (RR) with 95% confidence limits (CI).⁸

C. Administrative Interventions

1. Access to Sharp Knives/Scissors

The questionnaire asked how often the participant received sharpened knives or scissors and whether she received training on how to steel the knife or scissors.

2. Job Rotation Program

The questionnaire asked if the participant was in a job rotation program, when that program began, and the time spent by the participant rotating to other jobs.

3. Training Program

The questionnaire asked whether the participant received training in cutting techniques, and whether she received education on the early signs of UE CTDs.

D. Medical Management

1. Access to the First Aid Department and Physician Evaluation

Participants who had upper extremity symptoms were asked whether the foremen or supervisors refused to allow them to seek nursing evaluation. The company nurse was available during the day-shift and first 2 hours of the evening-shift. Employees evaluated by the nurse were asked if they were referred for physician evaluation.

2. Missed and Restricted Days

- a) The OSHA 200 logs were used to compute the number of days off work and the number of days on restricted duty for UE CTDs. Medians, in addition to arithmetic means, are reported because of the skewed distribution of the missed and restricted days.
- b) Employees participating in NIOSH's prevalence study were asked the number of days off work and the number of days on restricted duty for UE CTDs.

V. RESULTS

A. Incidence Rates

Between 1/1/88 and 12/31/88, 256 entries were recorded on the OSHA 200 Logs, with 148 being checked under the column "Disorders associated with repeated trauma" (RTDs). After review of each entry, 5 RTDs were excluded because they involved the back, chest wall, or lower extremities. Thus, the total number of recorded upper extremity RTD cases for calendar year 1988 was 143.

The plant, as a whole, had a UE CTD incidence rate of 35 per 200,000 work hours [100 full-time workers (ftw) per year]. The deboning department had the highest rate, 49 per 100 ftw per year. (Table 2) The breast trimming job had the highest rate of UE CTDs, 125 per 100 ftw per year, followed by the thigh deboners, wing cutters, leg cutters/deboners, and knuckle cutters. (Table 3)

Hands and wrists were the most frequently affected areas (73% and 22%, respectively), followed by arms (22%), and shoulders (13%). (Table 4) Pain and swelling were the most common symptoms. (Table 5) Six cases of carpal tunnel syndrome were reported for an incidence rate of 1.5 cases per 100 ftw per year.

B. Prevalence Rates

1. Participation

Ninety-six workers were employed in the 7 jobs selected for the HEG. Six HEG workers were excluded from the study for one of three reasons: 1) their predominant job was not selected for interview and physical examinations (2 workers), 2) they were filled by males (4). Except for one employee who was on vacation, all of the eligible employees participated in the survey. Twenty-six workers were employed in the 3 jobs selected for the LEG. One was excluded from the survey because her predominant job was not one of the 3 jobs selected for interview and physical examination. Of the 25 eligible LEG employees, 1 was on vacation and 2 others refused to participate, resulting in a participation rate of 88% among the LEG, and 100% among the HEG. Thus, the study group consisted of 112 employees: 89 from the HEG, and 23 from the LEG.

2. Demographics

The mean age of participating employees was 29 years, and 95% were black. The mean length of employment was 26 months. Significant differences between the HEG and LEG employees were found with respect to age and length of employment. (Table 6)

3. Period Prevalence

One-hundred-and-two of the 112 (91%) participants workers reported UE CTD symptoms during the year preceding the survey. Fifty-three (47%) met the one-year period prevalence case definition; the hand/wrist joint area predominated. (Table 7) Employees in the HEG had an UE CTD period prevalence of 53%, while the LEG employees had an UE CTD period prevalence of 26% [(RR=2.02, 95% CI 0.99, 4.14), (Tables 7, 8)]. The one-year period prevalences of hand-wrist CTDs were 43% and 17% for the HEG and LEG, respectively [(RR=2.77, 95% CI 0.98, 7.85), (Tables 7, 8)].

4. Physical Examinations

Tendonitis and tenosynovitis were the most common conditions diagnosed on physical examination (42%) followed by tension neck syndrome (21%). (Table 9) Three of the 112 participating employees (3%) were diagnosed with carpal tunnel syndrome. (Table 9)

5. Point Prevalence

Thirty-five of the 112 workers had current UE CTDs by questionnaire and physical examination, for an overall point prevalence of 31%. Again, the hand/wrist joint area predominated. (Table 7) Employees in the HEG had an UE CTD point prevalence of 37%, while the LEG employees had a UE CTD point prevalence of 9% [(RR=4.26, 95% CI = 1.10, 16.48), (Tables 7, 8)]. The point prevalence of hand-wrist CTDs were 33% and 4% in the HEG and LEG, respectively [(RR=9.84, 95% CI 1.02, 95.06), (Tables 7, 8)].

For both the period and point prevalences, some individuals had more than one affected joint area.

6. Stratification

Adjusting for age and length of time on the current job did not significantly change the crude relative risks. (Tables 8, 10)

C. Administrative Interventions

1. Access to Sharp Knives

Of the 112 participating employees, 71 (63%) stated they used a knife at some point during their employment at the plant. Eight workers (11%) stated they received sharpened knives once per day, and 5 (62%) thought this was inadequate. Fourteen workers (20%) stated they received sharpened knives twice per day, and 7 (50%) thought this was inadequate. Thirty-eight workers (54%) stated they received sharpened knives three times per day, and 18 (48%) thought this was inadequate. Eleven workers (16%) stated they received sharpened knives 4 or more times per day, and 2 (19%) thought this was inadequate.

2. Access to Sharp Scissors

Of the 112 participating employees, 84 (75%) stated they used scissors at some point during their employment at the plant. Thirty-one workers (37%) stated they received sharpened scissors once per day, and 20 (65%) thought this was inadequate. Nineteen workers (23%) stated they received sharpened scissors twice per day, and 13 (68%) thought this was inadequate. Twenty-two workers (26%) stated they received sharpened scissors three times per day, and 11 (50%) thought this was inadequate. Twelve workers (14%) stated they received sharpened knives 4 or more times per day, and 2 (17%) thought this was inadequate.

3. Job Rotation Program

Of the 89 employees in the HEG, 71 (80%) were involved in a job rotation program. Although one worker's rotation program began in July 1988, the majority of workers began these programs after March 1989. These 71 workers rotated an average of 2 days per week for 3 hours per day among 4 jobs.

4. Training Program

a) Cutting Techniques

Of the 112 participating employees, 71 (63%) used a knife at some point during their employment. Fifty-eight of these 71 (82%) received training on proper cutting techniques. The instruction involved a mean of 6 hours per day, lasting a mean of 6 days. Thirty-nine of these 58 workers (67%) thought this amount of time was adequate.

b) Knife Sharpening

Of the 71 employees who used a knife at some point during their employment, 36 (51%) received training on how to sharpen knives. The instruction involved a mean of 2 hours per day, lasting a mean of 4 days. Twenty-seven of these 36 workers (75%) stated this amount of time was adequate.

c) Education on early symptoms of CTDs

Of the 112 participating employees, 6 (5%) received education on the early signs and symptoms of CTDs. The instruction involved a mean of 1 hours per day, lasting less than 1 days. Five of these 6 (83%) stated this amount of time was adequate.

E. Medical Management

1. Access to the First Aid Department

Of the 102 employees having any upper extremity symptoms, 10 (10%) (6 from the day shift, 4 from the evening shift) stated that at some point during the past year a foreman refused to let them go to the first aid department for evaluation.

Of the 53 employees satisfying our period prevalence case definition, 8 (15%) (4 from each shift) stated that at some point during the past year a foreman refused to let them go to the first aid department for evaluation.

Of the 35 employees satisfying our point prevalence case definition, 7 (21%) (3 from the day shift, 4 from the evening shift) stated that at some point during their employment a foreman refused to let them go to the first aid department for evaluation.

2. Nursing Evaluation

Of the 102 employees having any upper extremity symptoms, 61 (60%) (32 from the day shift, 29 from the evening shift) were evaluated in the first aid department by the plant nurse. Of the 53 employees satisfying our period prevalence case definition, 40 (76%) (19 from the day shift, 21 from the evening shift) were evaluated in the first aid department by the plant nurse. Of the 35 employees satisfying our point prevalence case definition, 26 (74%) (12 from the day shift, 14 from the evening shift) were evaluated in the first aid department by the plant nurse.

3. Physician Evaluation

Of the 102 employees having any upper extremity symptoms, 13 (13%) were evaluated by the plant physician. Of the 53 employees satisfying our period prevalence case definition, 7 (13%) were evaluated by the plant physician. Of the 35 employees satisfying our point prevalence case definition, 4 (11%) were evaluated by the plant physician.

4. Missed and Restricted Days

a) The OSHA 200 Logs

The mean number of days off work for the 143 RTD cases for calendar year 1988 was 0.5 days (median <0.1) with 140 (89%) having no days off work (range 0-47 days). The mean number of days on restricted duty was 5.0 days (median = 2.5); 45 (32%) had no restricted work days (range 0-40 days).

b) Prevalence Study

Of the 102 employees having any upper extremity symptoms, 3 (3%) were allowed time off work, and 36 (35%) were placed on a light duty job. Of the 53 employees satisfying our period prevalence case definition, 1 (2%) was allowed time off work, and 24 (45%) were allowed to work on a light duty job. Of the 35 employees satisfying our point prevalence case definition, 1 (3%) was allowed time off work, and 14 (40%) were allowed to work on a light duty job.

VI. DISCUSSION

A. Incidence Rates

The plant had an upper extremity CTD incidence rate of 34.9 per 100 full-time workers per year, compared to 2.6 reported for the poultry dressing industry (SIC code 2016) in 1987, [Rate Ratio (RR)=13.4, 95% confidence interval (CI) 11.4, 15.9].^{6,9} The HEG had an upper extremity CTD incidence rate of 55.6 per 100 full-time workers per year compared to 7.1 reported for the LEG [Rate Ratio (RR)=7.8, 95% Confidence Interval (CI) 2.0, 29.8].⁸ Several biases can influence this comparison. These include differences in: 1) access to the first aid department for symptomatic employees (ascertainment bias), 2) criteria for CTD diagnosis (misclassification bias), and 3) criteria for a work-related injury and/or illness being "recordable" onto the OSHA 200 Logs (reporting bias).

1. Recording Bias

The results of the medical interview and questionnaire suggest that not all Cargill workers had adequate access to the first aid facility. Thirteen of the 53 (25%) workers fulfilling our period prevalence UE CTD case definition were not evaluated in the first aid department: 8 were refused access and 5 did not seek nursing evaluation. This investigation did not address symptomatic worker's access to first aid facilities in other poultry dressing plants and therefore cannot predict the direction or magnitude of this bias.

2. Misclassification Bias

The diagnostic criteria for CTDs could vary between physicians and nurses in different poultry dressing plants; therefore, disease misclassification may be present on the OSHA 200 Log data. This misclassification may be very common among the reference poultry dressing plants because CTDs may be recorded as injuries, not as "RTDs".

3. Ascertainment Bias

The investigation excluded back, chest wall, and lower extremity CTDs. Therefore this plant's 34.9 episodes per 100 full time employees per year is an underestimate of all CTDs in this plant. After spending two weeks at the Cargill plant, our impression was that under-reporting of CTDs did not occur during the past year. This investigation did not address the extent of under-reporting of CTDs onto the OSHA 200 Logs among other poultry dressing plants.

Six cases of carpal tunnel syndrome (CTS) were reported on the OSHA 200 Logs, for an incidence rate of 1.5 per 100 ftw per year. A population-based study reported an age-adjusted incidence rate of 0.15 per 100 person-years for females.¹⁰ Using the population based study as a referent group, this plant's rate ratio for developing CTS would be 9.8 (95% CI 3.6, 21.3).⁶ It must be noted that the methods to identify CTS cases in this working population (OSHA 200 Logs) were very different from the methods used to identify CTS cases in the population based study (medical records), therefore this calculated rate ratio may not be accurate.

Three cases of carpal tunnel syndrome diagnosed by physical examination were found among current employees. All 3 cases were from HEG jobs, for a prevalence of 3.4%. Another study, using a similar questionnaire and physical examination, found a prevalence of 5.4% in workers employed in highly repetitive, highly forceful jobs.¹⁰

B. Prevalence Rates

The jobs with the highest incidence rates for UE CTDs on the OSHA 200 Logs had the higher UE CTD prevalences determined from the questionnaires and physical examinations. (Tables 3 & 7) The OSHA 200 Logs indicate that other high risk jobs exist within the deboning and evisceration departments, but we did not study these due to resource and time constraints. (Tables 2 and 3)

During the period 1/1/88 to 12/31/88 employee turnover was approximately 50%. This high rate of employee turnover suggests that survivor bias may be a substantial problem in our investigation. "Survivors" are usually healthier (that is, lacking illness or injury that would interfere with work) than those who have left employment. This "healthy worker" or "survivor" effect has been described in studies of other industries, and is an inherent bias of this study's cross-sectional design.¹² This selection bias does not invalidate the basic conclusion of this study: that all HEG jobs studied had a high percentage of employees with UE CTDs.

The elevated prevalence of UE CTDs among the HEG in this plant does not appear to be due to misclassification of disease status, misclassification of exposure status, selection bias, or age differences between the HEG and LEG.

1. Disease Misclassification

Disease misclassification is unlikely to have biased the prevalence rates because we identified cases using standardized techniques used in other epidemiological studies.^{12,13} The general agreement between the independently derived incidence and prevalence rates in terms of which jobs are the highest risk for developing UE CTDs, and the magnitude of that risk, suggests that misclassification can not explain the high rates observed in this investigation. In addition, the physician performing the physical examinations was blinded as to the questionnaire results and the HEG/LEG status.

2. Exposure Misclassification

Exposure misclassification (the UE CTD occurring on a previous job within the plant) was occurring in the LEG. No HEG employees stated their symptoms began with a LEG job; most LEG employees stated their symptoms began with a HEG job. For this reason the point prevalence (the employee was currently suffering from an UE CTD) is a more accurate measure of which job caused the problem. This finding is probably responsible for the higher relative risks among the point prevalence cases compared to the period prevalence cases. (Table 8) In addition, most of the LEG jobs are repetitive (job cycle less than 30 seconds) and therefore are not truly low exposure jobs. This can explain the relative high number of UE CTDs (9%) among employees in the LEG. Employee with truly low exposure jobs should have a prevalence of approximately 1%.¹³

3. Selection Bias

Selection bias, as discussed above, would likely result in the finding of erroneously low, rather than high, prevalence rates.

4. Confounding Variables

Although age was a potential confounding variable, stratifying for age (less than or equal to 35 years vs. greater than 35 years) resulted in no significant difference between the crude and summary relative risks. (Table 8) As was the case for age, the length of employment on a particular job did not result in significant differences between the crude and summary relative risks. (Table 11) This investigation did not collect information on hobbies with the potential for aggravating UE CTDs and cannot comment of the potential confounding bias this introduces. Other reported risk factors for carpal tunnel syndrome (pregnancy, and oral contraceptives) were not controlled because only 3 cases were diagnosed as carpal tunnel syndrome. None of these 3 cases were pregnant or currently using oral contraceptives.

C. Administrative Interventions

1. Access to Sharp Knives and Sharp Scissors

Providing sharp knives or sharp scissors probably lowers a job's force requirements, thereby probably lowering the CTD potential of a particular job. Employees report that sharp knives are needed at least 4 times per day, yet only 16% of workers stated they were receiving sharpened knives 4 or more times per day. Employees report that sharp scissors are also needed at least 4 times per day, yet only 14% of workers stated they were receiving sharpened scissors 4 or more times per day. It is reasonable to accept employees' impressions of how often sharp knives/scissors are needed because as increasing numbers of sharpened knives or scissors were provided per day, an increasing percentage of employees felt they were receiving an adequate supply. (see Results Section, V. C. 1,2)

2. Job Rotation

Most employees in high risk jobs are involved in a job rotation program (80%), with employees reporting, on the average, rotating only two days per week. For a job rotation program to be successful, the rotation schedule may need to be implemented on a daily basis. In addition, many employees began the job rotation after acquiring a CTD. Job rotation should be used as an CTD prevention program rather than a form of treatment for employees with UE CTDs. Although job rotation is frequently mentioned as a method to prevent CTDs, its effectiveness has never been established in a scientific study. The job rotation program in this plant may be of limited effectiveness because employees are rotated among high exposure jobs, rather than between high and low exposure jobs.

3. Training

Most employees received training in how to properly cut the meat, and the majority of employees felt the amount of time devoted to this training was adequate. Most employees reported the amount of time devoted to training on how to sharpen their knives was adequate, but only 51% of employees using a knife stated they had received this training. As mentioned previously, maintaining a sharp cutting edge reduces the force requirements of a particular job and should help to preventing the emergence of a CTD.

D. Medical Management

Preventing and limiting the severity of UE CTDs requires the evaluation by trained medical personnel when symptoms of UE CTDs first appear. With only 60% of employees with UE CTD symptoms reportedly evaluated by the plant nursing personnel, and only 14% of employees with significant work-related UE CTDs (period prevalence cases) having been referred for physician evaluation, we concluded that this area of Cargill's effort to prevent CTDs needs improvement.

After sustaining a CTD injury, an inflamed tendon, ligament, or nerve needs rest. One of the 52 employees we considered to have a significant work-related UE CTD was allowed time off work, and only 24 (46%) were allowed to work on a light duty job. The mean number of days off work for any upper extremity CTD in Sweden's meatpacking industry in 1983 was 53 days.¹⁴ It must be noted that these two data sources (our questionnaire and physical examination data and Sweden's occupational disease system) probably differ in their CTD case definitions, and our data may contain less severe types of UE CTDs. None the less, this difference is striking. The UE CTD algorithm supplied by Health and Hygiene (the consulting firm hired by Cargill to address the UE CTD medical management issues) will be helpful in treating UE CTDs. Our comments and additions to this algorithm are contained in the recommendations section.

VII. CONCLUSION

Our investigation found a high incidence rate of upper extremity (UE) CTDs among workers at the Cargill Poultry plant in Buena Vista, Georgia for the one-year period 1/1/88 thru 12/31/88. This may be partially related to the fact that the company made a concerted effort to accurately record UE CTDs onto the OSHA 200 Logs during calendar year 1988. From the questionnaires and physical examinations performed on the 112 participating employees, a high prevalence of UE CTDs, particularly hand-wrist CTDs, was found among current employees. Over the six months prior to NIOSH's investigation, the company had initiated several programs to curb CTD problems within this plant. After complete implementation of these programs, time will be needed to determine each program's effectiveness. At the time of this investigation the company needed to: a) ergonomically evaluate all high risk jobs identified on the OSHA 200 Logs (see Recommendations Section, VIII A 1); b) provide sharp knives and scissors to employees at least 4 times per day (see Discussion Section, VI C 1); c) implement the job rotation program among high and low exposure jobs on a daily basis (although caution must be used for two reasons: one, the effectiveness of a job rotation program has never been proven, and two, different jobs may appear to have different stressors but they may actually pose the same physical demands); d) use job rotation as a CTD prevention program rather than a form of treatment (see Discussion Section, VI C 2); e) improve implementation of the knife sharpening training program (see Discussion Section, VI C 3); f) improve access of symptomatic workers to the first aid department for nursing evaluation; g) refer employees with significant work-related UE CTDs for physician evaluation; h) improve access to restricted (light) duty jobs for employees with significant work-related CTDs; i) expand the number of restricted (light) duty jobs available at the plant; and j) include employees, foremen, and supervisors in the UE CTD education program emphasizing the need for early evaluation and treatment of CTD symptoms.

VIII. RECOMMENDATIONS

Prevention and management of occupational upper extremity CTDs can be categorized into 3 areas: engineering, administrative, and medical.

A. Engineering

All jobs with 1) high rates of CTDs on the OSHA 200 Log [all jobs in the deboning department (with the exception of trainers, relief, thigh and breast inspectors, flank cutter, yolk remover), and several jobs in the evisceration department], or 2) jobs with known risk factors for CTDs (i.e. high repetition, forceful exertions, and/or extreme or awkward postures) need careful ergonomic assessment to determine the need for job re-design at reducing or eliminating the risk factors.

After an ergonomic assessment is made, the following general recommendations, when appropriate, should be implemented to reduce CTD risk factors.

1. High Repetition

Reduction of highly repetitive movements or cuts can be accomplished by slowing down the main line or providing diverging conveyors off the main line so that certain activities can be performed at slower rates. Automation, increasing the number of employees performing a task, or restructuring jobs so that each worker's task is varied and in balance with other jobs on the line, are other ways of reducing repetitiveness. Because the work area is already cramped, adding workers to the lines without increasing the work area could result in injuries (i.e. lacerations, amputations) from another employee.

2. High Force

Excessively forceful exertions can be reduced in intensity by either using mechanical devices to aid in deboning and cutting, or automating processes. Maintaining sharp cutting edges on knives and scissors, and installing adjustable fixtures that allow employees to maintain mechanically advantageous postures (i.e. close to the body) can also reduce excessively forceful exertions.

3. Extreme Postures

Reduction of extreme postures can be achieved by (a) re-orienting the knife or tool handle, (b) providing adjustable fixtures (as above), and (c) providing work stations and delivery bins that accommodate the heights and reach limitations of workers of various sizes.

The design of effective engineering controls is best done with input from the employees and supervisors who will be affected by these changes.

B. Administrative

Although we recommend training, job rotation, and rest pauses as administrative prevention measures, none of these programs have been validated in a scientific study to prevent CTDs. In addition, none of the administrative controls are important as the engineering controls.

1. Training

Training new employees should involve demonstrations and time to practice proper cutting techniques, and knife care. New employees should be given the opportunity to condition their muscle-tendon groups prior to working at full capacity. Conditioning can be accomplished by putting new employees on slower paced lines, varying each worker's task (mentioned previously), or job rotation (discussed below). This training should be done over the course of several weeks.

2. Job Rotation

The principle of job rotation is to alleviate physical fatigue and stress of a particular set of muscle-tendon-nerve groups by rotating employees among one or two other jobs that use different muscle and tendons. Caution must be used in deciding which jobs to rotate employees through. Although different jobs may appear to require the use of different muscle-tendon-nerve groups, they may actually pose the same physical demands. Rotation schedules should be designed to ensure that the benefits to some employees are not compromised by subjecting other employees (who must share the ergonomically hazardous tasks) to excessive musculoskeletal stresses.

3. Rest Pauses

Rest pauses can relieve fatigued muscle-tendon groups. The length and frequency of these rest pauses depend on the task's overall effort and total cycle time.

C. Medical

1. Health Care Providers

Health care providers should be knowledgeable in (1) the prevention, recognition, treatment, and rehabilitation of CTDs, and (2) the basic principles of ergonomics and epidemiology. In addition, they should be familiar with OSHA recordkeeping requirements. At the minimum, an occupational health nurse (OHN) should be available on each shift.

2. Workplace Walk-throughs

Health care providers should conduct routine systematic workplace walk-throughs to understand processes and work practices, identify CTD risk factors, and become aware of any potential restricted (light) duty jobs. These walk-through surveys should be conducted every month or whenever job tasks change significantly.

3. Catalog of Job Descriptions

The ergonomist or other similarly qualified person should ergonomically assess every job and provide health care personnel with the results of this assessment.

4. CTD Surveillance

a. Active and Passive Surveillance

The first goal of the surveillance program is to determine (1) the types of symptoms and CTDs that are occurring, and (2) whether the incidence of these problems is increasing, decreasing or remaining stable.

To accomplish this goal, the OSHA 200 Log should be analyzed, and a questionnaire administered to all workers. The questionnaire should be administered once a year or whenever there are major changes in processes, and should elicit information regarding (1) the location, frequency, and duration of work-related CTD symptoms, (2) job titles, time on the job, and average weekly hours worked, and (3) employees' perceptions about causes of injuries. Employees' names should not be required on questionnaires as fear of repercussions for reporting symptoms can lead to the collection of inaccurate data.

b. Screening

The second goal of the surveillance program is to detect CTD's in order to facilitate early treatment, including appropriate job restrictions.

To accomplish this goal, a symptom questionnaire should be administered to and a brief physical examination performed on all employees by the health care provider. This should be done once a year, or after an employee moves to a different job. Appendix C provides an example of a CTD questionnaire adapted from the NIOSH study. It is important to note that this is not a pre-placement exam and should not be used to screen potential workers.

5. Employee Education

All employees, including supervisors and other management personnel, should be educated on the prevention and treatment of CTDs. The information should be reinforced by health care providers during workplace walk-throughs and physical examinations. New employees should be educated during orientation. Education programs facilitate the early recognition of CTDs (prior to the development of severe, disabling conditions), and increase the likelihood of compliance with prevention and treatment programs.

6. Prophylactic Pills and Exercises

Although vitamins, anti-inflammation medications, and a variety of exercise programs have been advocated as effective methods of preventing work-related CTDs of the upper extremity, NIOSH is unaware of any valid, scientific research that establishes the effectiveness of these interventions.^{15,16} In addition, these interventions are not adequate substitutes for effective engineering and administrative controls. Finally, the regular consumption of therapeutic amounts of ibuprofen, a commonly used anti-inflammatory agent is associated with a risk of various adverse health effects, including perinatal complications.¹⁷

7. Evaluation, Treatment, and Follow-up of CTDs

If CTDs are recognized and treated early in their development, debilitating conditions may be prevented. Symptomatic employees should be guaranteed access to the plant nurse whenever requests are made. The nurse should take a medical history and perform a limited physical examination including inspection, palpation, assessment of strength and range of motion (passive, active, and resisted), and performance of various diagnostic maneuvers, such as Tinel's test, Phalen's test, and Finkelstein's test. Laboratory tests, x-rays and other diagnostic procedures should not be done routinely.

Any employee with (1) numbness or crepitus, (2) a positive Tinel's, Phalen's, or Finkelstein's test, and (3) evidence of medical or lateral epicondylitis should be referred to a physician. If a physician referral is not necessary, the treatment regime outlined in the Upper Extremity (UE) Cumulative Trauma Disorder (CTD) Algorithm (Appendix D) should be followed. This algorithm outlines a conservative approach to treating CTDs employing the use of the following therapies:

a) Aspirin or Other Non-Steroidal Anti-Inflammatory Agents (NSAIA's)

These agents are helpful in reducing inflammation and pain. A complete list of these agents is included in Appendix E.

b) Ice Packs

Ice reduces inflammation associated with CTD's and should be used even if no overt signs of inflammation are present (i.e. redness, warmth, or swelling). Ice should be applied to affected areas 4 times per day, for 20 minutes each time. Heat treatments should be used only for muscle strains where no inflammation is present.

c) Exercises

Once CTDs have occurred, in general, passive range of motion exercises should be initiated. If active exercises are utilized for employees with CTD's, they should be administered under supervision of the occupational health nurse, a physician, or a physical therapist. If these active exercises are performed improperly, they can aggravate existing conditions.

d) Light/Restricted Duty

Job reassignment must be done with knowledge of whether new tasks will require use of injured muscles or tendons, or put pressure on injured nerves. Inappropriate reassignment can exacerbate CTD's and result in permanent disability. Appropriate light duty jobs can be selected from the catalog of job descriptions.

e) Splints

Splints can be used to help immobilize symptomatic muscles, tendons, and nerves. They should not be used during work unless the affected employee has been transferred from his/her job, and it has been determined by the health care provider that the new job does not stress the muscle-tendon-nerve group being splinted.

It is important to note that although the algorithm includes many commonly accepted treatments for CTD's, the effectiveness of these treatments has not been validated in scientific studies. In addition, many of the treatments may have serious side effects: anti-inflammatory agents can cause gastrointestinal irritation and bleeding; and active stretching exercises, without supervision, can exacerbate CTD symptoms; THEREFORE, ANY CTD PREVENTION PROGRAM SHOULD PLACE PRIMARY EMPHASIS ON REMOVING CTD RISK FACTORS, RATHER THAN RELYING ON THE MEDICAL TREATMENT OF SYMPTOMATIC EMPLOYEES.

Concerning surgery, (1) "second opinions" should be obtained before surgery is done, and (2) after surgery, appropriate time off work should be provided to allow all injured muscle-tendon-nerve groups and operative sites to heal. The exact number of days off work will vary from employee-to-employee. For carpal tunnel surgery, the following averages have been proposed as guidelines.^{18,19}

for returning to a non-repetitive, non-forceful job (job with cycle time of 5 minutes or more, that never requires lifting objects over 1 pound, using hand tools, or pinching or gripping) - 3 weeks off (minimum 10 days)

for returning to a low-moderately repetitive, low-moderately forceful job (job with cycle time between 30 seconds and 5 minutes, that requires lifting objects less than 2 pounds during most job cycles, or occasionally using hand tools; use of key strokes acceptable) - 6 weeks off (minimum 21 days)

for returning to a highly repetitive, highly forceful job (job with cycle time less than 30 seconds, that requires lifting more than 2 pounds during most job cycles, or regularly using hand tools requiring forceful exertions) - 12 weeks off (minimum 42 days)

It must be emphasized that these are averages. Some workers may require more or less time, depending on individual responses to surgery. Also, these recovery times are the opinion of the authors of published articles and do not represent NIOSH policy. (The authors emphasize that recovery time is generally a matter of 2-3 months, and not 2-3 weeks.

After an employee has been away from work for medical reasons, he/she should be evaluated by a physician. This evaluation should include an assessment of his/her work capabilities. The physician should either view the required tasks from a videotape, or, preferably, see them first-hand in the plant.

Every time an employee is evaluated, treated or followed-up, the encounter should be documented in the employee's medical records.

D. Other

A CTD prevention and management program should be developed and implemented with input from health care providers, management, and employees. To accomplish this, a committee composed of representative of these groups should be set up, with members of the committee (1) being educated about basic ergonomic and medical principles of CTD's, (2) systematically assessing all jobs ergonomically, (3) designing a prevention and management program, and (4) evaluating the effectiveness of the program.

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X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared by:

Thomas R. Hales, M.D.
Medical Officer, NIOSH, Region VIII
Division of Preventive Health Services
Denver, Colorado

Lawrence Fine, M.D., DrPH
Director
Division of Surveillance,
Hazard Evaluations, and Field Studies
National Institute for Occupational
Safety and Health
Cincinnati, Ohio

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address. Copies of this report have been sent to:

1. Cargill Poultry Division
2. Retail, Wholesale, and Department Store Union
3. U.S. Department of Labor/OSHA - Regions IV, VIII.
4. Georgia State Health Department

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

NUMBER OF HOURLY EMPLOYEES BY DEPARTMENT
 CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
 HETA 89-251

<u>DEPARTMENT</u>	<u>#EMPLOYEES</u>	<u>% OF TOTAL</u>
Deboning	264	65%
Evisceration and Wholebird	39	10%
Pack Out	69	17%
Slaughter (Receive and Hang)	12	3%
Quality Control	12	3%
Maintenance	<u>13</u>	<u>3%</u>
TOTAL	409	101%*

* Rounding Error

TABLE 2

INCIDENCE RATES OF UPPER EXTREMITY CTDs REPORTED
ON OSHA 200 LOGS (1/1/88 TO 12/30/88) BY DEPARTMENT

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

<u>DEPARTMENT</u>	<u>OSHA Log Cases</u>	<u>Incidence Rate*</u>
Deboning	130	49
Evisceration and Wholebird	8	17
Pack Out	5	7
Slaughter (Receive and Hang)	0	0
Quality Control	0	0
Maintenance	0	0
Total (Whole Plant)	143	35

* Incidence Rate = # of upper extremity CTDs per 100 full time employees per year.

TABLE 3

INCIDENCE RATES OF UPPER EXTREMITY CTDs REPORTED ON OSHA 200
LOGS (1/1/88 TO 12/30/88) IN THE DEBONING DEPARTMENT BY JOB TITLE

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

<u>JOB TITLE</u>	<u>OSHA Log Cases</u>	<u># of employees</u>	<u>Incidence Rate*</u>
Breast Trimmer	10	8	125
Thigh Deboner	23	32	72
Wing Cutter	21	32	66
Leg Cutter/Disjointer	9	16	56
Final Cutter	17	32	53
Tender Cutter	4	8	50
Knuckle Cutter	8	16	50
Skin Puller	3	8	38
Line Loaders	3	8	38
Breast Puller	4	16	25
Thigh Bone Popper	2	8	25
Thigh Fat Trimmer	4	16	25
Yolk Cut/Frame Remover	2	8	25
Breast Inspector	2	8	25
Flank Cutter	1	0	6
Thigh Inspector	0	8	0
Relief	0	0	0
Trainer	0	0	0
Quality Control**	0	10	0

* Incidence Rate = # of upper extremity CTDs per 100 full time workers per year.

** Quality Control employees working on the deboning line.

TABLE 4
 SYMPTOMATIC AREA AS REPORTED ON THE OSHA 200 LOGS
 CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
 HETA 89-251

	<u>Number of Cases With Area Affected*</u>	<u>Percentage of Cases</u>
Hands	104	73%
Wrists	31	22%
Arms	32	22%
Shoulders	19	13%
Thumbs	6	4%
Forearms	5	4%
Elbow	2	1%
Upper Arms	1	1%
Neck	0	0%

* The total number exceeds the 143 entries since more than one joint area or more than one symptoms could be reported in a single log entry.

TABLE 5

SYMPTOMS DEFINED AS UPPER EXTREMITY
CTDs REPORTED ON THE OSHA 200 LOGS

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

<u>SYMPTOMS</u>	<u>Number of Cases With Reported Symptoms*</u>	<u>Percentage of Cases</u>
Pain	91	64%
Swelling	29	20%
Numbness	9	6%
Sore	8	6%
Carpal Tunnel Syndrome	6	4%
Cyst	5	4%
Tendonitis	3	2%
Tingling	2	1%
Strain	1	1%
Bursitis	1	1%
Cramp	1	1%
Callous	1	1%

* The total number exceeds the 143 entries since more than one joint area or more than one symptoms could be reported in a single log entry.

TABLE 6

AGE, RACE, AND LENGTH OF EMPLOYMENT BY EXPOSURE GROUP

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

	<u>Overall</u>	<u>HEG¹</u>	<u>LEG²</u>	<u>P value</u>
Age (mean) (range)	29 yrs (18-57 yrs)	27 yrs (18-53 yrs)	36 yrs (21-57 yrs)	<0.001*
Race				
% Black	95%	97%	87%	0.067**
% White	5%	3%	13%	
Length of Employment	26 months	20 months	48 months	<0.001*

1 - HEG = High Exposure Group

2 - LEG = Lower Exposure Group

* - Wilcoxon two-sample test

** Fischer's exact test

TABLE 7
 SELF-REPORTED CTD SYMPTOMS, AND UPPER EXTREMITY CTD CASES
 BY JOINT AREA AND CURRENT JOB EXPOSURE GROUP

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
 HETA 89-251

	Number in Group	Any Symptoms # (%)	Period Prevalence Case ¹ # (%)	Point Prevalence Case ¹ # (%)
<u>Neck</u>				
HEG ²	89	45 (51%)	19 (21%)	11 (12%)
LEG ³	23	15 (65%)	3 (13%)	0
Combined	112	60 (54%)	22 (20%)	11 (10%)
<u>Shoulder</u>				
HEG	89	44 (49%)	17 (19%)	6 (7%)
LEG	23	10 (43%)	1 (4%)	1 (4%)
Combined	112	54 (48%)	18 (16%)	7 (6%)
<u>Elbow</u>				
HEG	89	22 (25%)	9 (10%)	1 (1%)
LEG	23	2 (9%)	0	0
Combined	112	24 (21%)	9 (8%)	1 (1%)
<u>Hand/Wrist</u>				
HEG	89	80 (90%)	38 (43%)	29 (33%)
LEG	23	12 (52%)	4 (17%)	1 (4%)
Combined	112	92 (82%)	42 (38%)	30 (27%)
<u>Any Joint Area</u>				
HEG	89	84 (94%)	47 (53%)	33 (37%)
LEG	23	18 (78%)	6 (26%)	2 (9%)
Combined	112	102 (91%)	53 (47%)	35 (31%)

1 Defined in the Methods Section

2 - HEG = higher exposure group

3 - LEG = lower exposure group

TABLE 8
 CRUDE AND SUMMARY RELATIVE RISKS BETWEEN EXPOSURE GROUPS
 BY JOINT AREA CONTROLLING FOR AGE.
 (See Table 7 for Prevalences)

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
 HETA 89-251

	Crude RR ¹	Summary RR ¹	Summary CI ²	P Value ³
<u>Any UE CTD Symptoms</u>				
Neck	0.78	0.71	0.45, 1.10	0.20
Shoulder	1.14	1.15	0.67, 1.98	0.78
Elbow	2.84	3.25	0.57, 18.47	0.22
Hand/Wrist	1.72	1.74	1.11, 2.73	<0.01
Any Joint Area	1.21	1.16	0.90, 1.50	0.20
<u>Period Prevalence⁴</u>				
Neck	1.64	1.31	0.40, 3.19	0.91
Shoulder	4.39	3.77	0.62, 22.80	0.20
Elbow	Undefined ⁵			
Hand/Wrist	2.46	2.77	0.98, 7.85	0.04
Any Joint Area	2.02	2.02	0.95, 4.26	0.06
<u>Point Prevalence⁴</u>				
Neck	Undefined ⁵			
Shoulder	0.96	0.96	0.13, 7.29	0.60
Elbow	Undefined ⁶			
Hand/Wrist	7.49	9.84	1.02, 95.06	0.01
Any Joint Area	4.26	4.26	1.05, 17.30	0.03

1 = Relative Risk

2 = 95% Confidence limits for summary RR

3 = Mantel - Haenszel

4 = Defined in Methods Section

5 = No cases among the LEG

6 = No cases among the LEG or HEG

TABLE 9

FREQUENCY OF SPECIFIC UE CTD DIAGNOSES FOUND ON PHYSICAL EXAMINATION

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

<u>Diagnosis</u>	<u>#</u>	<u>(%)</u>
Tendonitis, Tenosynovitis	47	(42%)
Tension Neck Syndrome	24	(21%)
Non-Specific PIP Joint	21	(19%)
Rotator Cuff Tendonitis	16	(14%)
Osteoarthritis of the Wrist	11	(9%)
deQuervain's Disease	5	(4%)
Definite Trigger Finger	4	(3%)
Medical Epicondylitis (golfer's elbow)	4	(3%)
Carpal Tunnel Syndrome	3	(2%)
Bicipital Tenosynovitis	2	(2%)
Lateral Epicondylitis (tennis elbow)	1	(1%)
Ulnar Nerve Compression	0	(0%)
Cervical Root Syndrome	0	(0%)

TABLE 10

CRUDE AND SUMMARY RELATIVE RISKS BETWEEN EXPOSURE GROUPS BY
JOINT AREA CONTROLLING FOR LENGTH OF TIME ON THE CURRENT JOB
(See Table 7 for Prevalences)

CARGILL POULTRY DIVISION, BUENA VISTA, GEORGIA
HETA 89-251

	Crude RR ¹	Summary RR ¹	Summary CI ²	P Value ³
<u>Any UE CTD Symptoms</u>				
Neck	0.78	0.71	0.45, 1.10	0.20
Shoulder	1.14	1.15	0.67, 1.98	0.78
Elbow	2.84	3.25	0.57, 18.47	0.22
Hand/Wrist	1.72	1.74	1.11, 2.73	<0.01
Any Joint Area	1.21	1.16	0.90, 1.50	0.20
<u>Period Prevalence⁴</u>				
Neck	1.64	1.78	0.56, 5.64	0.53
Shoulder	4.39	4.90	0.67, 35.82	0.13
Elbow	Undefined ⁵			
Hand/Wrist	2.46	2.26	0.92, 5.55	0.08
Any Joint Area	2.02	2.0	0.98, 4.05	0.05
<u>Point Prevalence⁴</u>				
Neck	Undefined ⁵			
Shoulder	1.81	1.92	0.24, 15.70	0.87
Elbow	Undefined ⁶			
Hand/Wrist	7.49	7.26	1.00, 52.91	0.02
Any Joint Area	4.26	4.20	1.05, 16.83	0.03

1 = Relative Risk

2 = 95% Confidence limits for summary RR

3 = Mantel - Haenszel

4 = Defined in Methods Section

5 = No cases among the LEG

6 = No cases among the LEG or HEG

APPENDIX A

SPECIFIC DIAGNOSES REFERRED TO AS UPPER EXTREMITY CTDS¹⁻⁴

Tendonitis

Strain

Carpal tunnel syndrome

Trigger finger, Stenosing tenosynovitis of the fingers

deQuervain's, Stenosing tenosynovitis of the thumb

Tennis elbow, Epicondylitis

Tenosynovitis

Myalgia, Myositis

Neuralgia, Neuritis

Synovitis

Bursitis

Ganglion cyst

Rotator cuff

Costochondritis

Irritation

Arthritis

Overuse Syndrome

APPENDIX B

DIAGNOSTIC CRITERIA FOR SPECIFIC DISORDERS

Symptomatic employees were asked to quantitate their pain on a scale of 0 to 8. Zero represents no pain, while 8 represents the worst pain that individual has ever experienced.

NECK

A. Tension Neck Syndrome

1. Palpable muscle tightness, hardening, or 2. Pain greater than or equal to (GE) 3 on passive or resisted neck flexion or rotation.

B. Cervical Root Syndrome

1. Pain (GE 3) radiating from the neck to one or both arms with numbness in the hand.

SHOULDER

A. Bicipital Tenosynovitis

1. Positive Yergason's test*

B. Rotator Cuff Tendonitis

1. Pain (GE 3) in deltoid muscle on resisted 90° abduction.

ELBOW

A. Lateral Epicondylitis (Tennis Elbow)

1. Pain (GE 3) at lateral epicondyle on resisted wrist extension, or
2. Pain (GE 3) at the lateral epicondyle on palpation.

B. Medial Epicondylitis (Golfer's Elbow)

1. Pain (GE 3) at medial epicondyle on resisted wrist flexion, or
2. Pain (GE 3) at the medial epicondyle on palpation.

* Yergason's test = pain in the bicipital groove on resisted supination with flexed elbow.

APPENDIX B cont.

HAND AND WRIST

- A. Ulnar Nerve Compression
 - 1. No cervical root disorder, and
 - 2. Positive Tinel's sign at Guyon's canal.*
- B. deQuervain's Disease
 - 1. Positive Finkelstein's test.**
- C. Carpal Tunnel Syndrome (cts)
 - 1. Positive Phalen's test***
- D. Definite Trigger Finger
 - 1. Palpable nodule at base of digit, or
 - 2. Locking in flexion or extension of digits.
- E. Tendonitis, Tenosynovitis
 - 1. Pain (GE 3) on resisted flexion or extension of the wrist, or fingers
- F. Osteoarthritis of the Wrist
 - 1. Passive range of motion (ROM) wrist pain (GE 3), and
 - 2. #1 GE E above.
- G. Non-Specific PIP Joint
 - 1. Pain (GE 3) in the PIP joint on palpation, or
 - 2. Swelling of the PIP joint, or
 - 3. ROM limitation of PIP joint.

* Gentle tapping over the ulnar nerve at the wrist resulting in pain, tingling, or numbness in the ulnar nerve distribution.

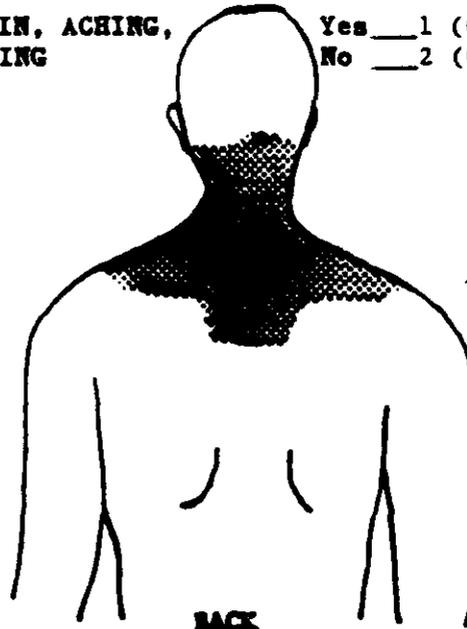
** Ulnar deviation of the hand with the thumb flexed against the palm and the finger flexed over the thumb. Severe pain results at the radial styloid due to stretching of the abductor pollicis longus and extensor pollicis brevis.

*** Unforced, complete flexion of the wrist for 60 seconds resulting in pain, numbness, or tingling in the median nerve distribution.

APPENDIX C
(UE CTD Questionnaire)

NECK

16. IN THE PAST TWO YEARS, HAVE YOU HAD PAIN, ACHING, STIFFNESS, BURNING, NUMBNESS, OR TINGLING IN THE AREA SHOWN ON THIS DIAGRAM? Yes ___1 (Continue) (5)
No ___2 (Go to page 3)

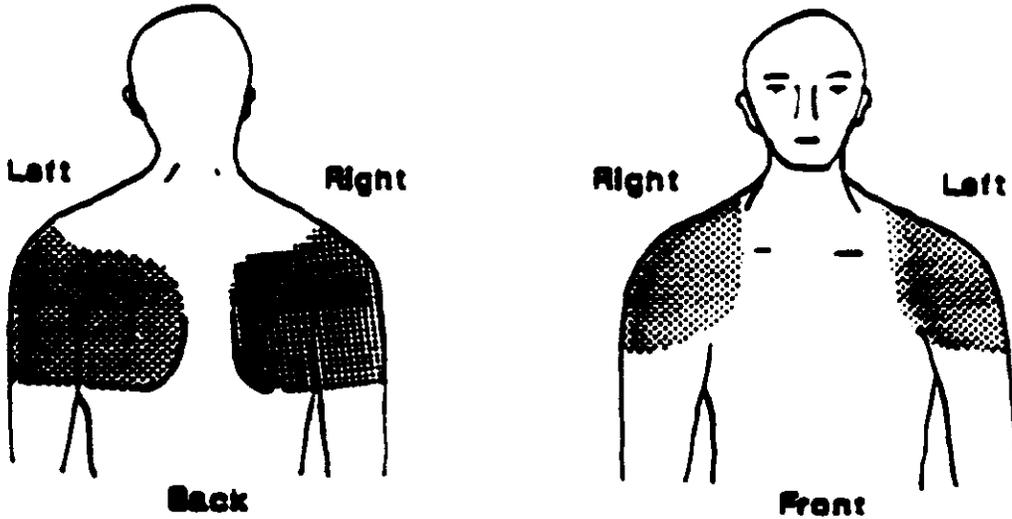


- a. HOW LONG DOES EACH EPISODE OF **NECK** PROBLEMS USUALLY LAST? (06)
 less than 1 hour.....1
 1 hour up to 8 hours.....2
 8 to 24 hours.....3
 24 hours or more.....4
- b. HOW MANY SEPARATE EPISODES OF **NECK** PROBLEMS HAVE YOU HAD IN THE PAST TWO YEARS? (07)
 1 to 4 episodes.....1
 4 or more episodes.....2
 Constant.....3
- c. HAVE YOU EVER HAD AN ACCIDENT OR SUDDEN INJURY TO YOUR **NECK** SUCH AS A WHIPLASH, A FRACTURE OR A SUDDEN SLIPPED DISK? Yes ___1 (08)
 No ___2
- d. WAS THE FIRST TIME YOU EXPERIENCED THIS **NECK** PROBLEM BEFORE OR AFTER YOU STARTED WORKING AT THIS PLANT? before ___1 (09)
 after ___2
- e. WHAT JOB WERE YOU ASSIGNED WHEN YOU FIRST EXPERIENCED THIS **NECK** PROBLEM? current job ___1 (10)
 other job ___2
 1. PLEASE LIST THE "OTHER JOB" - _____
- f. DO ACTIVITIES AT WORK MAKE THIS **NECK** PROBLEM WORSE? Yes ___1 No ___2 (11)
- g. DOES THIS **NECK** PROBLEM EVER WAKE YOU UP FROM SLEEP? Yes ___1 No ___2 (12)
- h. HAVE YOU EVER BEEN TREATED BY A PLANT DOCTOR OR NURSE FOR THIS **NECK** PROBLEM? Yes ___1 (13)
 No ___2
 HOW MANY TIMES? >>>> (14-16)
- i. WERE YOU GIVEN **WORKDAYS** OFF TO RECOVER FROM THE **NECK** PAIN? Yes ___1 No ___2 (17)
 1. HOW MANY DAYS WERE YOU OFF WORK? >>>> (18-20)
- j. WERE YOU GIVEN LIGHT/RESTRICTED DUTIES FOR THE **NECK** PAIN? Yes ___1 No ___2 (21)
 1. HOW MANY DAYS DID YOU DO "LIGHT DUTIES"? >>>> (22-24)
 2. DID THE PAIN IMPROVE WHILE ON LIGHT/RESTRICTED DUTY? Yes ___1 No ___2 (25)

SHOULDER

17. IN THE PAST TWO YEARS, HAVE YOU HAD PAIN, ACHING, STIFFNESS, BURNING, NUMBNESS, OR TINGLING IN THE AREA SHOWN ON THIS DIAGRAM?

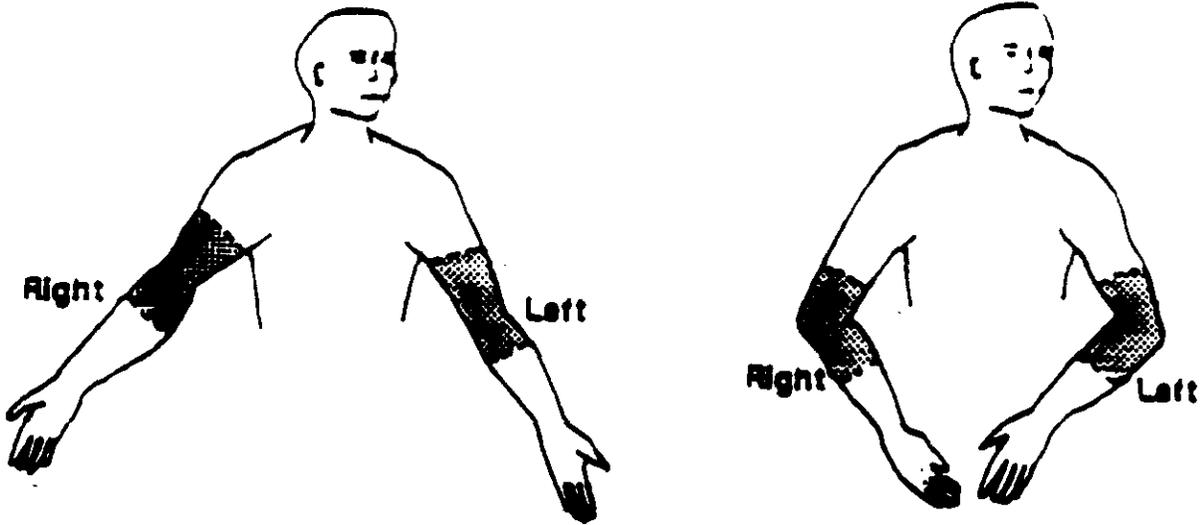
Yes ___1 (Continue) (5)
No ___2 (Go to page 4)



- a. HOW LONG DOES EACH EPISODE OF SHOULDER PROBLEM USUALLY LAST? (06)
- less than 1 hour.....__1
1 hour up to 8 hours.....__2
8 to 24 hours.....__3
24 hours or more.....__4
- b. HOW MANY SEPARATE EPISODES OF SHOULDER PROBLEMS HAVE YOU HAD IN THE PAST TWO YEARS? (07)
- 1 to 4 episodes.....__1
4 or more episodes.....__2
Constant.....__3
- c. HAVE YOU EVER HAD AN ACCIDENT OR SUDDEN INJURY TO YOUR SHOULDER SUCH AS A DISLOCATION, FRACTURE OR TENDON TEAR? Yes___1 (08)
No ___2
- d. WAS THE FIRST TIME YOU EXPERIENCED THIS SHOULDER PROBLEM BEFORE OR AFTER YOU STARTED WORKING AT THIS PLANT? before___1 (09)
after ___2
- e. WHAT JOB WERE YOU ASSIGNED WHEN YOU FIRST EXPERIENCED THIS SHOULDER PROBLEM? current job___1 (10)
other job___2
1. PLEASE LIST THE "OTHER JOB" = _____
- f. DO ACTIVITIES AT WORK MAKE THIS SHOULDER PROBLEM WORSE? Yes___1 No___2 (11)
- g. DOES THIS SHOULDER PROBLEM EVER WAKE YOU UP FROM SLEEP? Yes___1 No___2 (12)
- h. HAVE YOU EVER BEEN TREATED BY A PLANT DOCTOR OR NURSE FOR THIS SHOULDER PROBLEM? Yes___1 (13)
No ___2
1. HOW MANY TIMES? >>>> (14-16)
- i. WERE YOU GIVEN WORKDAYS OFF TO RECOVER FROM SHOULDER PAINS? Yes___1 No___2 (17)
1. MANY DAYS WERE YOU OFF WORK? >>>> (18-20)
- j. WERE YOU GIVEN LIGHT/RESTRICTED DUTIES FOR SHOULDER PAINS? Yes___1 No___2 (21)
1. HOW MANY DAYS DID YOU DO "LIGHT DUTIES"? >>>> (22-24)
2. DID THE PAIN IMPROVE WHILE ON LIGHT/RESTRICTED DUTY? Yes___1 No___2 (25)

ELBOW

18. IN THE PAST TWO YEARS, HAVE YOU HAD PAIN, ACHING, STIFFNESS, BURNING, NUMBNESS, OR TINGLING IN THE AREA SHOWN ON THIS DIAGRAM? Yes 1 (Continue) (5)
 No 2 (Go to page 5)

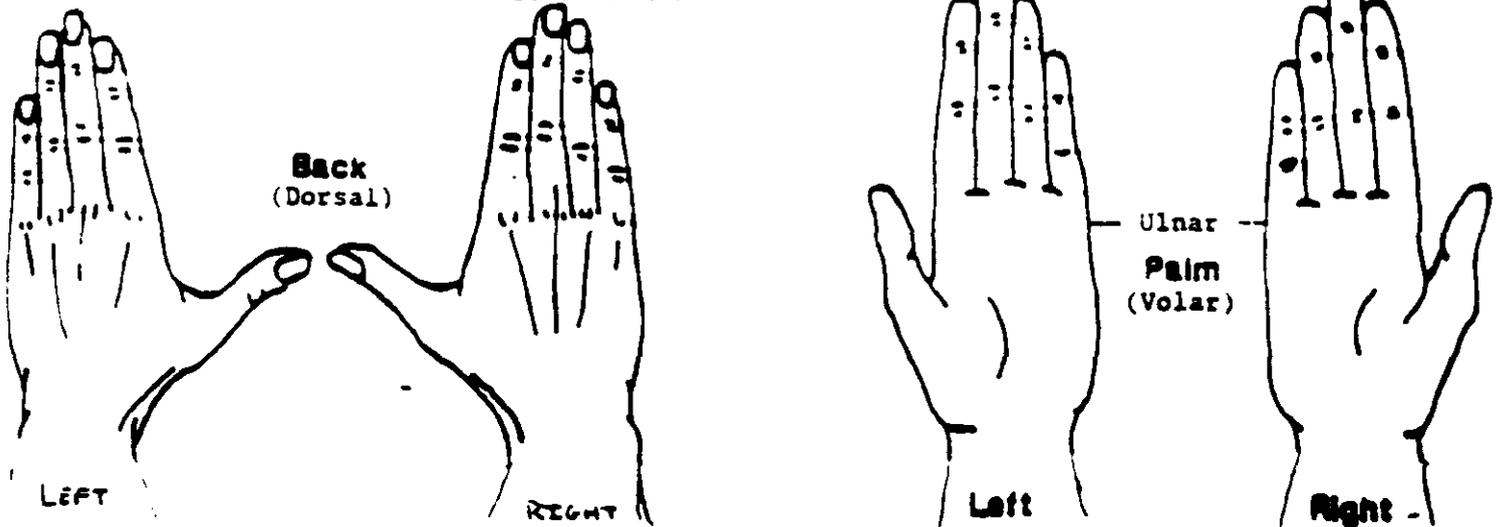


- a. HOW LONG DOES EACH EPISODE OF ELBOW PROBLEM USUALLY LAST? (06)
- less than 1 hour..... 1
 1 hour up to 8 hours..... 2
 8 to 24 hours..... 3
 24 hours or more..... 4
- b. HOW MANY SEPARATE EPISODES OF ELBOW PROBLEMS HAVE YOU HAD IN THE PAST TWO YEARS? (07)
- 1 to 4 episodes..... 1
 4 or more episodes..... 2
 Constant..... 3
- c. HAVE YOU EVER HAD AN ACCIDENT OR SUDDEN INJURY TO YOUR ELBOW SUCH AS A DISLOCATION, FRACTURE OR TENDON TEAR? Yes 1 (08)
 No 2
- d. WAS THE FIRST TIME YOU EXPERIENCED THIS ELBOW PROBLEM BEFORE OR AFTER YOU STARTED WORKING AT THIS PLANT? before 1 (09)
 after 2
- e. WHAT JOB WERE YOU ASSIGNED WHEN YOU FIRST EXPERIENCED THIS ELBOW PROBLEM? current job 1 (10)
 other job 2
 1. PLEASE LIST THE "OTHER JOB" = _____
- f. DO ACTIVITIES AT WORK MAKE THIS ELBOW PROBLEM WORSE? Yes 1 No 2 (11)
- g. DOES THIS ELBOW PROBLEM EVER WAKE YOU UP FROM SLEEP? Yes 1 No 2 (12)
- h. HAVE YOU EVER BEEN TREATED BY A PLANT DOCTOR OR NURSE FOR THIS ELBOW PROBLEM? Yes 1 (13)
 No 2
 1. HOW MANY TIMES? (14-16)
- i. WERE YOU GIVEN WORKDAYS OFF TO RECOVER FROM THE ELBOW PAIN? Yes 1 No 2 (17)
 1. MANY DAYS WERE YOU OFF WORK? (18-20)
- j. WERE YOU GIVEN LIGHT/RESTRICTED DUTIES FOR THE ELBOW PAIN? Yes 1 No 2 (21)
 1. HOW MANY DAYS DID YOU DO "LIGHT DUTIES"? (22-24)
 2. DID THE PAIN IMPROVE WHILE ON LIGHT/RESTRICTED DUTY? Yes 1 No 2 (25)

HAND AND WRIST

19. IN THE PAST TWO YEARS, HAVE YOU HAD PAIN, ACHING, STIFFNESS, BURNING, NUMBNESS, OR TINGLING IN THE AREA SHOWN ON THIS DIAGRAM?

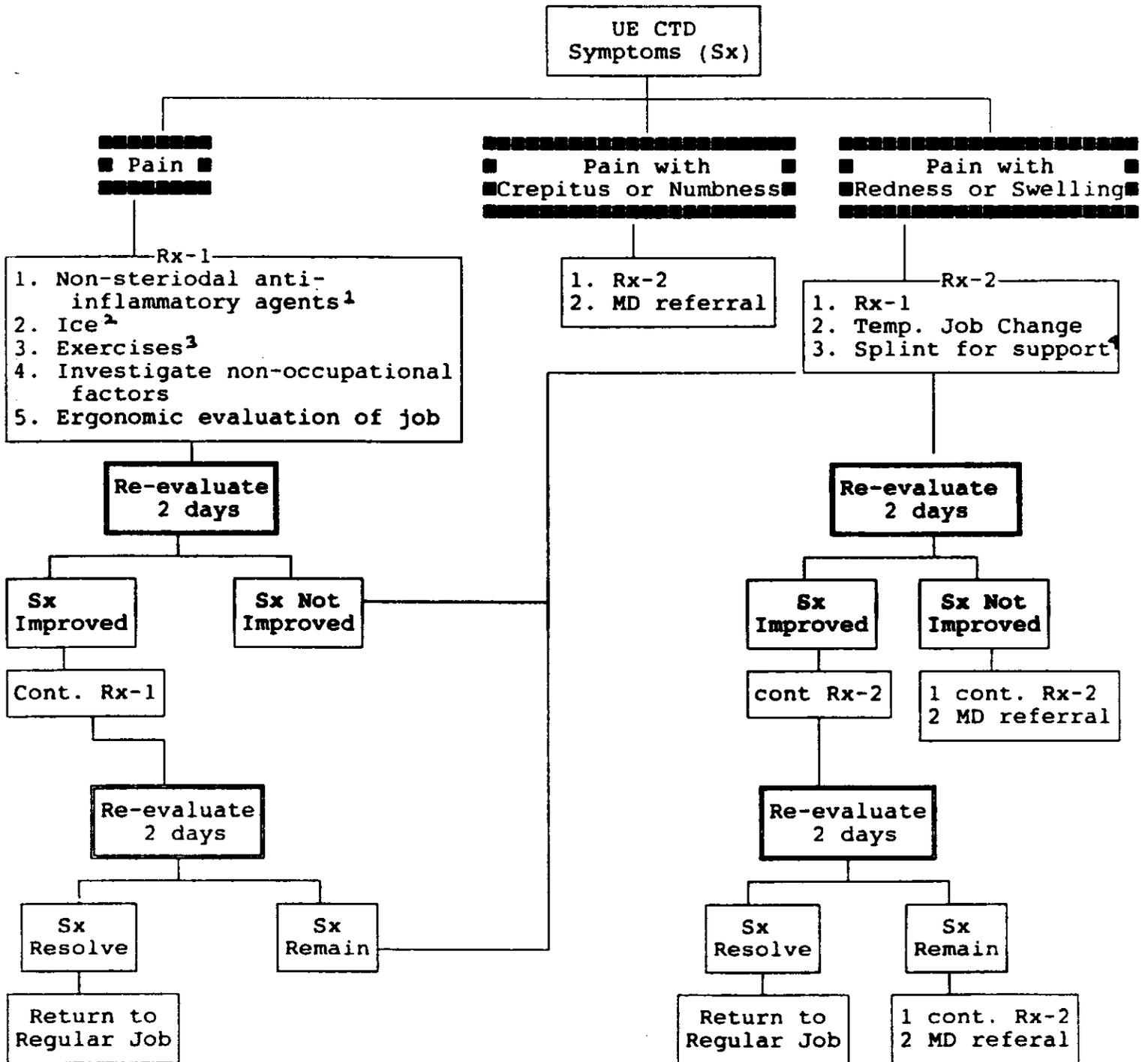
Yes ___ 1 (Continue) (5)
No ___ 2 (STOP)



- a. HOW LONG DOES EACH EPISODE OF HAND/WRIST PROBLEM USUALLY LAST? (06)
- less than 1 hour.....__1
1 hour up to 8 hours.....__2
8 to 24 hours.....__3
24 hours or more.....__4
- b. HOW MANY SEPARATE EPISODES OF HAND/WRIST PROBLEMS HAVE YOU HAD IN THE PAST TWO YEARS? (07)
- 1 to 4 episodes.....__1
4 or more episodes.....__2
Constant.....__3
- c. HAVE YOU EVER HAD AN ACCIDENT OR SUDDEN INJURY TO YOUR HAND/WRIST SUCH AS A DISLOCATION, FRACTURE OR TENDON TEAR? Yes___1 (08)
No ___2
- d. WAS THE FIRST TIME YOU EXPERIENCED THIS HAND/WRIST PROBLEM BEFORE OR AFTER YOU STARTED WORKING AT THIS PLANT? before___1 (09)
after ___2
- e. WHAT JOB WERE YOU ASSIGNED WHEN YOU FIRST EXPERIENCED THIS HAND/WRIST PROBLEM? current job___1 (10)
other job___2
1. PLEASE LIST THE "OTHER JOB" = _____
- f. DO ACTIVITIES AT WORK MAKE THIS HAND/WRIST PROBLEM WORSE? Yes___1 No___2 (11)
- g. DOES THIS HAND/WRIST PROBLEM EVER WAKE YOU UP FROM SLEEP? Yes___1 No___2 (12)
- g. HAVE YOU EVER BEEN TREATED BY A PLANT DOCTOR OR NURSE FOR THIS HAND/WRIST PROBLEM? Yes___1 (13)
No ___2
1. HOW MANY TIMES? >>>>> (14-16)
- h. WERE YOU GIVEN WORKDAYS OFF TO RECOVER FROM HAND/WRIST PAIN? Yes___1 No___2 (17)
1. MANY DAYS WERE YOU OFF WORK? >>>>> (18-20)
- i. WERE YOU GIVEN LIGHT/RESTRICTED DUTIES FOR HAND/WRIST PAIN? Yes___1 No___2 (21)
1. HOW MANY DAYS DID YOU DO "LIGHT DUTIES"? >>>>> (22-24)
2. DID THE PAIN IMPROVE WHILE ON LIGHT/RESTRICTED DUTY? Yes___1 No___2 (25)

APPENDIX D

UPPER EXTREMITY (UE) CUMULATIVE TRAUMA DISORDERS (CTD) ALGORITHM



- 1 - Aspirin 650 mg PO qid or Ibuprofen 400 mg PO qid.
- 2 - Ice to area for 20 minutes qid.
- 3 - Exercises under nursing supervision for first day.
- 4 - Only if no wrist bending is required.

APPENDIX E

List of Commonly Used Non-Steroidal Anti-inflammatory Agents*

<u>Generic Name</u>	<u>Trade Name</u>
1. Aspirin and Salicylates (plain, buffered, or enteric-coated)	Many
2. Sulindac	Clinoil
3. Diflunisal	Dolobid
4. Piroxicam	Feldene
5. Indomethacin	Indocin
6. Ibuprofen	Motrin, Advil, Nuprin, Rufen
7. Naproxen	Naprosyn
8. Tolmetin	Tolectin
9. Meclofenamate	Meclomen
10. Fenoprofen	Nalfon
11. Mefenamic acid	Ponstel
12. Phenylbutazone	Butaxolidin, Azolid
13. Oxyphenbutazone	Oxalid

* - List derived from Robinson, DR. Chapter 15 X: Osteoarthritis. In: Rubenstein E, Federman DD, editors Scientific American Medicine. New York: Scientific American, Inc 1986:6. This list does not constitute endorsement from the National Institute for Occupational Safety and Health (NIOSH).