A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Telephone line staff from 6 districts in Australia whose outdoor work involves exposure to solar UV radiation, a risk factor for skin cancer. (Borland, Hill, Gibbs, Cappiello, 1990)	To reduce lineman exposure to sunlight especially during the 11 A.M.–3 P.M. summer hours through wearing hats and shirts, and application of maximum protection sunscreen to exposed skin.	An educational campaign "Cover yourself against skin cancer" was used to promote worker actions for maximizing protection against solar/UV hazards. Planned weekly poster displays plus a video segment of a young man dying of melanoma to alert people to avoid excessive sun exposures were distributed at depot stations with folders for each worker containing information on the campaign. Buttons urging protective measures and anticancer brochures were also included. Nurse staff also added inputs on sun protective needs.	Three telephone districts, the intervention groups, were subject to the campaign activities; three others (controls) were given only normal occupational health-safety care. A checklist was used by senior staff to observe sun protective actions taken by linemen during 11 A.M.–3 P.M. duty hours. The checklist rated type of hat/shirt coverings and extent of shade available/used to derive an overall protection score. These data were collected for intervention and control groups 2 weeks before the campaign (late Nov) and during the last 3 weeks in late Feb/early March.	The report notes that the telephone linemen campaign took place in the context of a large community based "SunSmart" effort by an anticancer council. The authors suggest that the worker effort, being more focussed, may have provided added impetus for effecting the prescribed behavior changes.	Pre- vs. post-campaign comparisons for the intervention groups showed little difference in wearing of hats (less than a 2% difference in type/frequency of head covering); a greater difference in wearing shirts (especially short-sleeved, which rose 65% at the expense of no upper body attire), and tendencies to work more in partial shade. Combining all measures into a single protection index, the intervention group had an overall 6% higher protection factor than the control group.	Statistical analyses found weather conditions (temperature, cloud cover) during pre/post observations to have no effects on the reported results. Checks on biases in observation, and repeated observations on the same linemen proved unfounded or adjusted for in the reported analyses. Effort shows the merit of a marketing approach especially in reaching large numbers of a target audience.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
7368 medical personnel (physicians, dentists, and technicians) and 1084 nonmedical (power plant) workers from different regions of Taiwan requiring licensing for use of equipment having sources of or generating ionizing radiation. (Cheng, Yang, and Wu, 1982)	To ensure knowledge of safe use of ionizing radiation sources and equipment used in hospitals, clinics, laboratories, and industry and of means for radiation monitoring and protection. Evidence of passing final examinations in the training courses was needed for issuing an operating license.	1-week training courses were given, the contents differing for medical and nonmedical personnel and professional or technician level persons. Material was presented via lectures, movies, and on-site demonstrations. Instructors were senior faculty members of universities, research institutions, government agencies. Class size was limited to 40 persons.	Effectiveness judged by number of persons passing the final course examinations for a 6-year period of offerings for the medical personnel and a 4-year period for the nonmedical group; also by tracking the nationwide trend in per capita exposure dose obtained from the film badges worn by medical and nonmedical personnel for the time period 1960 to 1979.	Inspection for licensing different sources/types of radiation equipment found in medical facilities, industry, and nonmedical establishments was also undertaken during the time of the training as part of regulations issued by the Atomic Energy Council of Taiwan.	Overall percentage of medical personnel passing the test was 87.9%. The passing rate for nonmedical persons was 80.5%. Radiation dose beginning in 1970 and continuing through 1979 showed a decreasing trend coinciding with the introduction of the training and licensing actions noted. The per capita drop in dose from 1970 to 1979 averaged 80% across the different personnel groups.	These results offer a nationwide picture of an intervention effort where standards imposing controls thru licensing of sources and users of radiation equipment plus training requirements played a role in reducing exposure levels. The exact contribution of the training or its quality in producing this result cannot be determined.

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
94 active full-time city firefighters showing evidence of high frequency hearing loss suggesting needs for hearing conservation measures. (Ewigman, Kivlahan, Hosokawa, & Horman, 1990)	To increase firefighter knowledge of noise hazards to hearing and how it can be prevented through use of ear protective devices. The need for this training was based on 1) a survey of sources/levels of firefighter noise exposure (e.g., engines, horns/sirens, pumps) which found 78% of the measurements to range between 89 and 110 dbA, and 2) 20% of firefighter audiograms showing threshold losses of 40 to 60 dB in hearing 3000-, 4000-, and 6000-Hz test frequencies in one or both ears and 14% with still greater losses.	The intervention effort included 1) a 1-month education program using hand-outs, videotapes, lectures, and interviews with afflicted firefighters on noise hazards, hearing loss disability, and aspects of prevention, 2) issuance of 3 types of ear protective devices (roll-up foam plugs, premolded plugs, and ear muffs) for use during emergency runs for a 2-month trial.	Questionnaires mailed at the start and end of the 1-month education program to assess knowledge of noise hazards and hearing loss risks, attitudes toward wearing ear protective devices and indications of use in emergency runs. At the end of the 2-month trial period with ear protectors, interviews held to learn of problems and actual use over that time.	Fire department administrators supportive of the intervention, but they did not direct any firefighter to use ear protectors nor did they issue a policy on use of such protection during the trial use period.	Post-education questionnaire results found significant knowledge gains (average 14%; key items showed more than 25% increase), and positive attitude shift toward use of ear protectors (15%–20% shift noted for key items). At end of 2-month trial, 85% noted use of ear protectors as compared with only 20% use before.	Authors note that after the study the fire department provided ear protectors to all personnel and issued a policy requiring their use on runs. 6 months after intervention, shift commanders reported most firefighters regularly using ear devices. Practical limits on use also recognized, e.g., interferes with communications at fire scene, time to shape foam plugs poses problems as does wearing certain muffs under fire helmets.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Ten 8-person teams of nuclear power plant control room operators and adjunct staff having needs to respond to unforeseen, dangerous events. (Janssens, Grotenhuis, Miichiels, & Verhaegen, 1989)	To effect teamwork capabilities in detecting and correctly evaluating unusual, potentially dangerous events through strategies emphasizing the continuous and spontaneous exchanges of information among the team members.	3-day training began with discussions of case incidents in other plants, a fictional situation in their own plant and inspections of their plant to detect deviations for transmittal to others for action. Intent was to promote teamwork and exchange of ideas. A simulated plant disturbance was programmed, and the team went about a problem-solving exercise. Different teammembers paired off to learn one another's job, thus opening added means for communication.	Team members noted the extent to which the training improved communications and information exchange in handling unusual events by ratings on a 10-item scale. Scale covered skill in solving problems as a team, transfer of messages between shifts, feedback on disturbances, quality of information exchange with superiors, etc. Only posttraining evaluations conducted some years after the instruction.	None elaborated.	10 teams indicated significant improvements in different communication activities (e.g., problemsolving as a team, information exchange with superiors and others in maintenance, and from one shift group to another). No significant improvement noted for skills in operating components that cannot be routinely serviced, adequacy of control room layout, and skills in actually managing disturbances.	Evaluation lacks a more objective scheme for rating the effectiveness of the training, especially in coping with untoward events. Results are encouraging in showing improved communications, but skills in actually managing a crisis situation seem to be unaffected.

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
1716 workers in a complex of 8 plants, each with similar noise levels (averaging 90 dBA), plant processes, workforce size, and percentage of ear protector use. (Karmy & Martin, 1980)	To determine the effects of education in hearing conservation (through posters plus use of a videotape depicting the need to wear ear protection in excessive noise), repeat audiometry, and education + audiometry on ear protector use.	Workers in 8 plants comprised 4 treatment groups: 1) education, 2) repeat audiometry, 3) education + repeat audiometry, and 4) control. Education was a poster campaign with 6 poster designs advocating use of hearing protection started midway in a 22-month study period, followed by a videotape showing on hearing conservation at 13 months. Audiometry started at 3 months and repeated 7 to 12 months later on same workers.	Main measure was to compare the increase in percentage of workers observed to be wearing ear protectors before and after the various treatment conditions.	Results of repeat audiograms not given workers.	Ear protector use in 2 plants serving as controls remained at 5% across the whole 22-month period of data collection. In comparison, use of just posters starting at 11 months caused a 15% increase in ear protection, which then declined; adding the videotape at the 13 month point caused an upsurge in use rate by 25%. Audiometry by itself increased ear protection by 40% in one plant and 20% in a second. Repeat audiometry + education attained a maximum 30% increase in protector use.	The authors suspect that differences in time between successive audiograms was responsible for one plant showing a greater ear protection effect than did the other. Also, giving workers knowledge of their audiograms would have increased its effect. Still audiometric testing proved to have the greatest effect, which seemed more sustained than the educational approach. The effect of the latter treatment appeared less durable.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Labor force size of 120 doing heavy industrial maintenance work in a gas diffusion plant with exposures to high wet bulb globe temperatures, i.e., 34.4˚C WBGT in summer; 26.6˚C WBGT at other times. (Millican, Baker & Cook, 1981)	To educate and train workers to recognize heat stress hazards and adopt measures to reduce risk of heat stress incidents. Also to train supervisors in maintaining close surveillance of workers in hot areas and in exercising control actions (e.g., mandatory rest breaks) as warranted.	Through safety films, booklets, medical alerts, safety meetings, and plant industrial hygiene bulletins, employees taught to recognize first signs of heat exhaustion and made aware of preventive measures. Emphasis on self-pacing of work tasks, taking breaks as needed in special cool rooms, increasing water intake, and avoiding heavy high fat meals before hot work duties.	Analyzed record data of exposure time, the number of heat stress incidents, type of work performed, and size of workforce over a 6-year period which were the peak years for the heat stress control program at the plant site.	Besides education and training efforts, transportable cool rooms were located near work areas for workers to take breaks of more than 3–5 minutes and air conditioners were installed in crane cabs to control temperature. Large refrigeration units also were used from time to time to pump cool air into work enclosures. Dry ice cooling vests were made available to workers but were not used.	Record data for moderate level work during the hotter summer months (WBGT 30˚C–38˚C) for the 6-year period 1974–1980 yielded 3 heat stress incidents for 700,000 hours of work. The nonsummer months, (WGBT 23˚C–30˚C) for the same 6-year period found no heat stress cases for 1.7 million hours of work. Time studies showed workers adopted a 50-50 to 75-25 work regimen in pacing themselves per instruction.	Authors note one heat stress incident due to air conditioner failure in a crane cab and was thus not a training associated problem. Authors emphasize success of program in limiting heat stress cases was the result of administrative controls (training, self-pacing, supervisor surveillance) plus the physical control measures put in place (cooling rooms). Study lacked reference data to gauge true program effectiveness.

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Unspecified number of enlisted personnel engaged in aviation maintenance work where noise levels dictated needs for hearing protection. (Sadler & Montgomery, 1982)	To motivate greater use of ear plugs or donning earmuffs in high noise areas among exposed personnel.	Treatment group subjected to psychological techque of positive practice overcorrection (i.e., if caught w/o ear protectors, would stop and practice inserting ear plugs or donning ear muffs 5 times) to increase ear protector use. The treatment was applied by non-commissioned officers in either a leader directed (LD) or leader participative (LP) manner. A second group (control) had daily safety briefings to reinforce need for hearing protection.	NCO leaders made unannounced visits and unobtrusive observations of the frequency of ear protector usage among their personnel during a 1-week period before the technique was applied, for 2 weeks during the application process, and two weeks after the treatment ended. During the latter post-treatment period, participants rated the merits of the technique for increasing ear protector use.	Discussions held with NCO leaders to elaborate on the techniques to be used and their roles as observers. Enlisted men in orientation period told of procedures and entered into a verbal contract to adhere to the overcorrection technique. Each of these orientations took an hour.	Compared with pre-treatment measures, the LP group showed a 33% increase in ear protector use during the applications phase; the LD group a 19% increase. The control group change was 3%. For the post-treatment phase, the LP group dropped 15% in use level; the LD group lost 13%. The control group had a gain of 8% in the post-treatment level. The LP group rated the technique as most helpful and better than others for increasing ear protector use.	Although authors stress gains from use of either LD or LP overcorrective application, the losses in the post-treatment phase suggest the technique does not have lasting effect. Since the participants were told before the post-treatment period that they were no longer required to continue the technique, this could have been interpreted as permission to forgo wearing protectors.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
3 groups of workers, varying in size from 28 to 58, drawn from 3 worksites having noise levels between 85–92 dBA. (Yarrall, 1986)	To increase knowledge of noise hazards to hearing, and need for hearing conservation through use of hearing protectors.	3 group education sessions held at 1 site with audio-visual aids to elaborate on what noise is, hearing function, noise effects on hearing, use/types of hearing protectors. At 2nd site, each worker's hearing tested; the results were given by a nurse who counselled the person on hearing conservation in noise. Workers at the 3rd site served as control group with no instruction. Interventions spread over a period of 6 months to cover the workers/sites.	A pre/post questionnaire was used to determine the knowledge and attitude of the workers toward noise and the wearing of ear protectors, and a behavior survey was conducted at the 3 worksites to observe the number wearing ear protectors before and just after the intervention and for up to 9 months later.	Other than the monitoring to note actual use of ear protectors after the intervention, no other factor was noted.	Pre/post questionnaire data for the 2 intervention groups showed increased awareness of noise problems, knowledge of noise damage to hearing, and use of hearing protectors at work. The group with hearing tests + counselling showed the greatest shifts (17%–20%) for these measures as well as greater numbers observed to be wearing protectors during worksite inspections. However, the greatest level of actual ear protector use was only 40%.	Authors believe that interventions were strung out over too long a period without adequate reminder/reinforcing material (posters, print material), which diluted the effect. Authors recognized, too, the need for more management support to create greater impact.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

A-III. Control of Health Hazards—Physical Agents

Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
80–82 workers in each of two departments of metal fabrication plant exposed to noise levels 87–99 dBA. (Zohar, Cohen & Azar, 1980)	To promote greater awareness of noise hazard to hearing among workers at risk and increased motivation to wear protection.	Standard lecture on hearing conservation given workers in both departments. Add-on hearing tests given to those in one department along with interpretations of temporary threshold shifts (TTS) when wearing and not wearing ear protection during work shifts.	Observe earplug use during weekly tours of both departments for 1 month before and during 5 months after the training treatment phase.	Audiograms of workers who wore ear protectors and those who didn't posted in production halls to further stress benefit of use. Management's earlier efforts to promote use through posters and lectures were ineffective; disciplinary actions also failed.	Treatment groups receiving TTS feedback showed ear protector use to increase from 30–50% at baseline to 85–90% at end of the 5-month follow-on period. Lecture-only group use seldom exceeded 10% for the same period.	Widespread use of ear plugs with strong support by management established norms in department for maintaining the durability of such practices.New entry workers wore plugs without need for TTS feedback treatment.
180 weavers in one textile plant (A) exposed to 106 dBA noise levels; 70 weavers in a second textile mill with 109 dBA levels. (Zohar & Fussfield, 1981)	To promote greater awareness of noise hazards to hearing and to motivate greater use of ear protectors in noise.	Typical lecture on hearing conservation with emphasis on wearing ear protectors at the workplace.	Compare earplug use for 2 months before with that following the issuance of token rewards for periods ranging from 3 to 5 months.	Add-on feature in Plant A was for supervisors to issue token to workers wearing earplugs, which were redeemable for gifts. In Plant B, the token value depended on how many in the group were using the plugs. The tokens were given during a 2-month period and then discontinued.	For Plant A, earplug use increased from 35% to 90% just 1 week after token issuance began and remained unchanged for 5 months after the tokens stopped. Similar findings with Plant B.	Management involvement in this intervention and the token issuance aided in the behavioral change. Such widespread use established norms for ear protector use; this prompted new entry workers to follow same practices even without the token rewards.