The Impact of Occupational Exposures on the Prevalence of Distress of Line 1 Former Workers from the Burlington Atomic Energy Commission Plant (BAECP) in Southeast Iowa

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Background

Former Worker Medical Screening Program

- Under the 1993 Defense Authorization Act, Congress passed Public Law 102-484, Section 3162
  - Law required Department of Energy (DOE) [formerly Atomic Energy Commission, AEC] to evaluate the long-range health conditions of former employees who may be at risk for health problems as a result of their employment at DOE facilities

- In 2000, DOE contracted with The University of Iowa College of Public Health to coordinate and implement a medical screening program for those who formerly worked at the DOE-facility at the Iowa Army Ammunition Plant (IAAAP)

Iowa Army Ammunition Plant (IAAAP)

- IAAAP is a 19,000 acre facility in Middletown, IA (near West Burlington), Des Moines County
- Since 1943, IAAAP has housed a large Department of Defense (DoD) conventional weapons and explosives manufacturing facility, ~30,000 employees
- From 1949-1975, IAAAP had a previously secret atomic bomb assembly plant, known as Line 1/Burlington Atomic Energy Commission Plant (BAECP), ~5,000 employees
- From 1949-1951, BAECP was the only large scale manufacturer of nuclear weapons in the country
- In 1975, the nuclear weapons production moved to the Pantex Plant in Amarillo, TX
- IAAAP is still in operation manufacturing conventional weapons, current workforce approx. 1,000 employees

BAECP Line 1 Former Workers

1949-1975, approx. 5,000 employees

- Assembled, disassembled, modified, and tested nuclear weapons during Cold War period
- Conducted high explosives research to assist the national development of atomic weapons
- This work exposed former workers to many toxic substances: ionizing radiation, high explosives, solvents, beryllium, uranium, plutonium, asbestos, isocyanates, epoxy adhesives, and curing agents
- These toxic exposures can lead to a variety of occupational lung diseases and cancers

Psychological Stress Effects of Toxic Exposures

- Since Love Canal in the 1970s, there has been extensive documentation of the psychological responses and stress reactions worldwide among those exposed to hazardous substances.
  - Well-known toxic exposures disasters: Three Mile Island, Exxon-Valdez Oil Spill, Alaska, Chernobyl, Bhopal, India

- Characteristics of Toxic Exposures Disasters/"Technological Disasters"
  - Result from human activities
  - Invisible (contamination and health effects)
  - Largely invisible effects and damage
  - Occur over many years
  - Long-term uncertainty
  - Persistent stressors
  - Lack of control due to human error
  - Undefinable low point

Stressors Specific to Toxic Exposures

- Chronic perception of possible threats to health & safety
- Persistent **fear** of **threats**
- **Uncertainty:** invisible nature of exposure, possible latent health effects
- Feelings of **loss of control** over the present & future
- Learned helplessness
- Community conflict: who is to blame, what actions to take
- Economic losses
- Property value declines
- Frustration over the lengthy clean-up process
- Confusion over highly technical information
- Dealing with governmental agencies
- Insufficient medical and psychological services
  - Especially health care professionals trained in environmental health/toxic exposures
- Isolation and stigmatism, faction in community

Uncertainty:

- Exposure, dose, latency, diagnosis, etiology, prognosis, treatment, financial
- The invisible nature of most hazardous substances leads to cognitive uncertainty
- Uncertainty makes appraisal of the real degree of threat posed difficult and renders adaptation to the threat prolonged and uncertain
- How long a person suffers an uncertain threat correlates with impairment

Loss of Control:

- Uncertainty is associated with perceived (and real) feelings of loss of control
- Individual and community control is a key factor affecting stress responses
- Learning that events are uncontrollable results in motivational, cognitive and emotional deficits associated with learned helplessness

Fear and Threat:

- Fear is a rational response to an imagined or actual threat
- Persistent fear may cause chronic stress reactions
- Persistent, repeated exposures may become increasingly frightening if these are experienced as being unavoidable and are believed likely to lead to adverse health conditions

Symptoms of Chronic Stress

cognitive, emotional, behavioral, physiological reactions

Thinking	Feelings	Behavior
Short attention span	Mood swings	Impulsiveness
Poor concentration	Agitation	Packing
Memory problems	**Irritability**	Inactivity
Decision-making conflicts	Insecurity	Dependency
Slow thinking	Apprehension	Agitated movement
Can't see alternatives	**Anger**	Arguing
Confusion	**Anxiety**	Fighting
	Depression	Reduced productivity

Psychological Sequela

- Chronic worry
- Anxiety
- Clinical depression
- Anger
- Bodily symptoms of stress
  - High blood pressure
  - Elevated hormone levels
- Poor task performance
- Social isolation
- Loss of control
- Social conflict
- Marital stress
- Increased substance abuse & alcohol consumption
- Sleep disturbances
- Increased sick days
- Post Traumatic Stress Disorder
- Demoralization in community

Psychological Response of Former Workers Learning About Past Exposures

- Former workers learning about past exposures 50-60 years later can elicit specific stressors:
  - **Chronic worry**
  - **Uncertainty** (coping with invisible exposures, latent health effects)
  - **Anger**
  - **Shock** (toxic exposure was unknown)
  - **Betrayal** (they were told it was safe)
  - **Fear** (for future health and children, grandchildren's health)
- At increased risk for developing non-clinical stress reactions such as generalized anxiety, depression, and exhibiting symptoms of traumatic stress, PTSD

METHODS

- From 2001-2008, self-administered Health & Occupational History Questionnaire, developed by UI-FWP, was completed by 1,136 Line 1 former workers, in conjunction with their medical screening
  - Age: range 40-93, mean= 67, mode=77
  - Gender: Males= 929 (82%); Females= 207 (18%)
  - Marital Status: Married= 816 (72%); Separated= 7 (0.6%); Divorced= 137 (12%); Widowed= 126 (11%); Never married= 25 (2.2%)
  - Education: HS diploma/GED= 769 (68%); some college/AA= 168 (15%); college graduate= 104 (9%); master/doctorate degree= 31 (2.7%)
- 'Distress In Relation to Work' Scale: seven questions tapping into bothersome feelings/difficulties regarding sleep, anger, irritability, trouble concentrating, feeling down, effects on social activities, and reminders of work at BAECP
- Report frequencies of distress symptoms & by gender
  - Analysis conducted in MS Access and SPSS

RESULTS

Distress Among Line 1 Former Workers (n=1,136)

During the past year, how much were you distressed or bothered by these feelings or difficulties with respect to your work at BAECP?

Distress Symptoms	Most of the time n (%)	Little of the time n (%)	Never n (%)	TOTAL n (%)
1) Feeling downhearted and blue.	77 (7%)	321 (28%)	599 (53%)	**997 (88%)**
2) Your physical or emotional health interfered with attending your social activities (visiting, church going, etc.).	90 (8%)	183 (16%)	729 (64%)	**1,002 (88%)**
3) I have trouble falling asleep.	171 (15%)	250 (22%)	589 (52%)	**1,010 (89%)**
4) I have trouble staying asleep.	205 (18%)	265 (24%)	544 (48%)	**1,014 (90%)**
5) I feel irritable and angry.	95 (8%)	329 (29%)	586 (52%)	**1,010 (89%)**
6) I have trouble concentrating.	114 (10%)	281 (25%)	613 (54%)	**1,008 (89%)**
7) Reminders of my work at BAECP cause me to have physical reactions.	41 (4%)	141 (12%)	817 (72%)	**999 (88%)**
TOTAL, n (% of total responses)	**793 (11%)**	**1,770 (25%)**	**4,477 (64%)**	**7,040 (100%)**

Distress by Gender &
Proportion of Males' Distress Compared To Proportion of Females' Distress

males, n=929 females, n=207

Distress Symptoms	Male (n=929) n (% of males)	Female (n=207) n (% of females)	TOTAL (1,136) n (% of total)
1) Feeling downhearted and blue			
Most of the Time n (%)	66 (7%)	11 (5%)	**77 (7%)**
Little of the Time n (%)	275 (30%)	46 (22%)	**321 (28%)**
Never n (%)	477 (51%)	122 (59%)	**599 (53%)**
TOTAL	**818 (88%)**	**137 (86%)**	**997 (88%)**
2) Physical or emotional health interfered with attending social activities			
Most of the Time n (%)	72 (8%)	18 (9%)	**90 (8%)**
Little of the Time n (%)	156 (17%)	27 (13%)	**183 (16%)**
Never n (%)	595 (64%)	134 (65%)	**729 (64%)**
TOTAL	**823 (89%)**	**179 (87%)**	**1,002 (88%)**
3) Trouble falling asleep			
Most of the Time n (%)	150 (16%)	21 (10%)	**171 (15%)**
Little of the Time n (%)	200 (22%)	50 (24%)	**250 (22%)**
Never n (%)	478 (52%)	111 (54%)	**589 (52%)**
TOTAL	**828 (90%)**	**182 (88%)**	**1,010 (89%)**
4) Trouble staying asleep			
Most of the Time n (%)	172 (19%)	33 (16%)	**205 (18%)**
Little of the Time n (%)	220 (24%)	45 (22%)	**265 (24%)**
Never n (%)	440 (44%)	104 (50%)	**544 (48%)**
TOTAL	**832 (87%)**	**182 (88%)**	**1,014 (90%)**

Distress by Gender &
Proportion of Males' Distress Compared To Proportion of Females' Distress

males, n=929 females, n=207

Distress Symptoms	Male (n=929) n (% of males)	Female (n=207) n (% of females)	TOTAL (1,136) n (% of total)
5) Feel irritable and angry			
Most of the Time n (%)	82 (9%)	13 (6%)	**95 (8%)**
Little of the Time n (%)	281 (30%)	48 (23%)	**329 (29%)**
Never n (%)	467 (50%)	119 (58%)	**586 (52%)**
TOTAL	**830 (89%)**	**180 (87%)**	**1,010 (89%)**
6) Trouble concentrating			
Most of the Time n (%)	98 (11%)	16 (8%)	**114 (10%)**
Little of the Time n (%)	236 (25%)	45 (22%)	**281 (25%)**
Never n (%)	494 (53%)	119 (58%)	**613 (54%)**
TOTAL	**828 (89%)**	**180 (88%)**	**1,008 (89%)**
7) Reminders of work at BAECP caused physical reactions			
Most of the Time n (%)	34 (4%)	7 (3%)	**41 (4%)**
Little of the Time n (%)	115 (12%)	26 (13%)	**141 (12%)**
Never n (%)	671 (72%)	146 (71%)	**817 (72%)**
TOTAL	**820 (88%)**	**179 (87%)**	**999 (88)**

Summary

- Over one-third of Line 1 former workers experience distress symptoms (36%)
- Line 1 former workers have trouble staying asleep (18%), trouble falling asleep (15%), and trouble concentrating (10%) 'most of the time'
- Line 1 former workers feel irritable and angry (29%), downhearted & blue (28%), and trouble concentrating (25%) 'a little of the time'
- In general, more males experience all seven distress symptoms than females
- There is a greater proportion of males who have the following distress symptoms 'most and little of the time' compared to females:
  - Feel downhearted and blue:
    - males 'most of the time' (7%), 'little of the time' (30%);
    - females 5%, 22% respectively
  - Trouble staying asleep:
    - males 'most of the time' (19%), 'little of the time' (24%);
    - females 16%, 22% respectively
  - Feel irritable and angry:
    - males 'most of the time' (9%), 'little of the time' (30%);
    - females 6%, 23% respectively
  - Trouble concentrating:
    - males 'most of the time' (11%), 'little of the time' (25%);
    - females 8%, 22% respectively
- The same total proportion of males (16%) and females (16%) have experienced physical reactions with reminders of their work at the BAECP

DISCUSSION, IMPLICATIONS

- Line 1 former workers experience symptoms of distress, anxiety and depression, which may be in part a sequela of anxieties regarding unknown health risks and working in an environment of maximal security and secrecy
  - An explanation for males having more distress symptoms than females is that more men worked in the production areas and more women worked in the administrative/services areas of the Plant (i.e., secretarial, cafeteria, laundry room)
- It is important for health care professionals to be aware of and recognize potential psychological disorders in Line 1 former workers and the management of their emotional condition
- Former workers' concerns are addressed by effective health risk communication and supportive counseling, through acknowledging Line 1 former workers' concerns, which may help diminish stress, calm anxieties, and reduce non-compliance and alienation from health care providers

Iowa Army Ammunition Plant (IAAAP)

19,000 acre facility, Middletown, IA (near West Burlington)

1943-present, manufactures conventional weapons (under DoD contract)

From 1949-1975, manufactured nuclear weapons (under DOE contract)

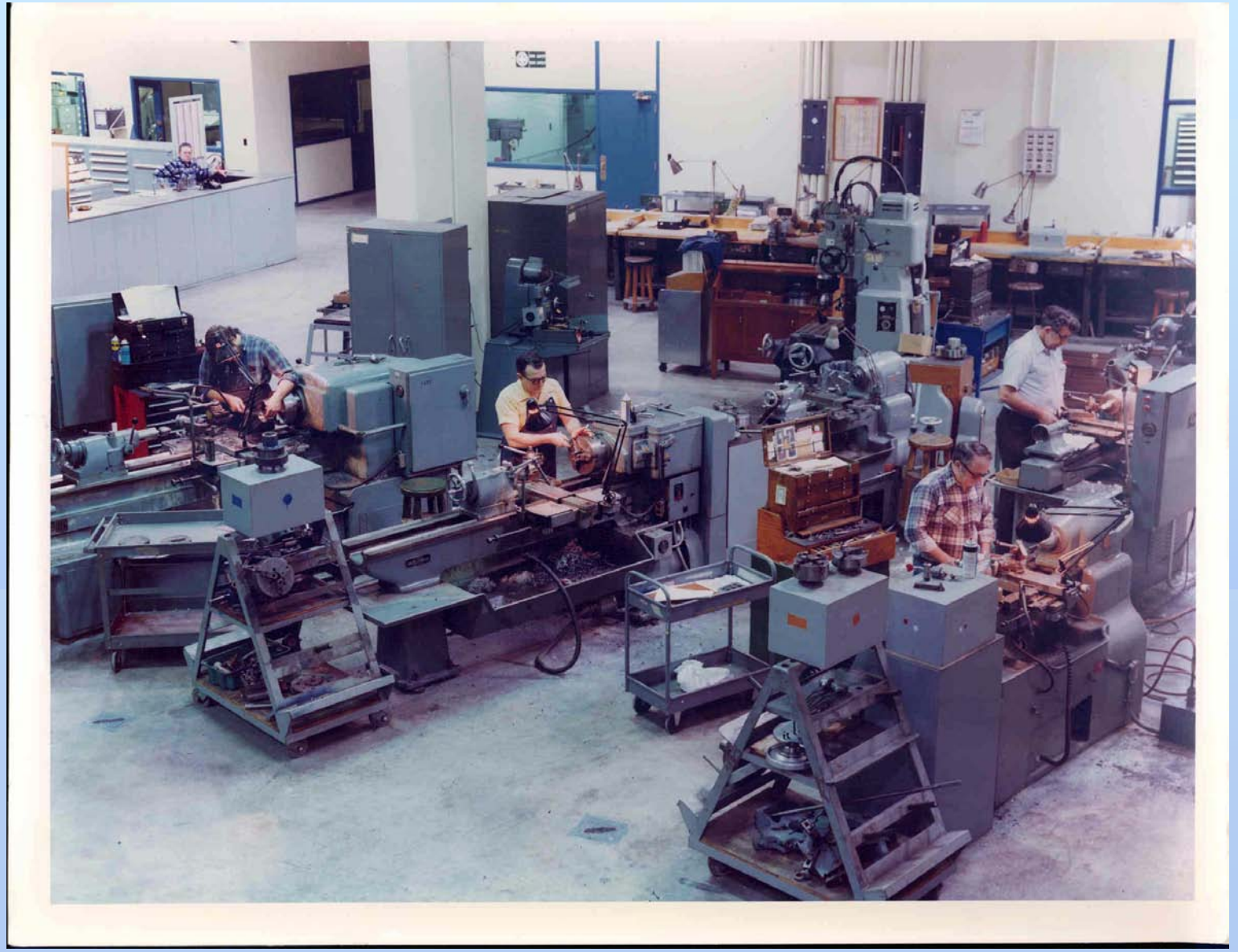
Underground Assembly Sites

"Gravel gerties" are concrete structures whose roofs consist of cable mesh supporting large amounts of gravel. Beneath them are bays, where workers assemble and disassemble nuclear warheads. Should a warhead's conventional explosives accidentally detonate, the roofs of these structures are engineered to give way, releasing the gravel and trapping the plutonium particles. Up to 2,000 warheads per year are now being dismantled at this site. *Pantex Plant, Amarillo, Texas. November 18, 1993.*

Line 1 Underground Facility

This underground waste-disposal room, excavated in 1986, was the first of 56 chambers to be excavated at the WIPP. It is 300 feet long, 33 feet wide, and 13 feet tall and could hold six thousand 55-gallon drums of transuranic waste. It lies 2,150 feet below the surface of the earth. *Room 1 of Panel 1, Waste Isolation Pilot Plant, near Carlsbad, New Mexico. February 25, 1994.*

Line 1 Production, Machine Room



Machining with Beryllium Tools

UI- Former Worker Program Medical Screening