Session 2: Examples of Medical Surveillance Programs

3:15 pm – National Institute for Occupational Safety and Health Beryllium Research Program
  * Christine Schuler, PhD – NIOSH

3:55 pm – Medical Surveillance in the Recycling Industry
  * Jean-Paul Robin, MD – Noranda

4:35 pm – Beryllium Health Surveillance in US Department of Energy Facilities
  * Arthur Stange, PhD – Oak Ridge Institute for Science and Technology
National Institute for Occupational Safety and Health
Beryllium Research Program

Christine Schuler, PhD
Epidemiologist
Division of Respiratory Disease Studies, Field Studies Branch

2005 International Beryllium Research Conference
March 8, 2005
Montreal, Quebec
What is surveillance?

Surveillance means continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation, and evaluation of morbidity reports and other relevant data for the purposes of prevention of disease.
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In early 1990s, Kay Kreiss and colleagues at National Jewish Medical & Research Center conducted first plant-wide surveys at Brush Wellman beryllium production facilities

- 1992 – beryllium oxide ceramics facility
- 1993-94 – beryllium metal, oxide and alloy production plant
Background on NIOSH Program

- Brush Wellman used knowledge gained from those surveys to make changes in workplace.

- In 1997, David Deubner (Brush Wellman corporate medical director) contacted NIOSH to ask for assistance with beryllium research.
  - Memorandum of Understanding signed in 1998.
How to understand risk?

In earlier studies, risk had been assessed by lung exposure to mass concentration of beryllium
- Inconsistent exposure-response relations

In addition to mass lung exposure, we are looking at:
- **Type** of beryllium exposure: size of particles, chemical form, surface area
- **Where** exposure occurs: role of dermal exposure in sensitization
- **Individual response** to exposure
NIOSH Beryllium Research Program

Relationship between beryllium exposure & sensitization or chronic beryllium disease

What happens to workers after they leave?

Are some more susceptible to sensitization and/or CBD?

What is the best way to measure beryllium exposure?

Is skin exposure related to sensitization?

Results lead to changes

Did changes have an effect?
The Epidemiologic Surveys

(1) 1998 – second survey conducted at ceramics plant

(2) 1999 – second survey conducted at metal, oxide and alloy production facility

(3) 2000 – first survey conducted at copper-beryllium alloy finishing plant

(4) 2000-01 – first surveys conducted at service and distribution centers, specialty metal facility; second partial survey at mine/mill

Follow-up of two worker cohorts from 1992 and 1993-94 studies (including former workers)
Responsibilities

**Current employees:**

- Brush Wellman – LPTs and other medical testing, questionnaire administration, historical exposure data
- NIOSH – human subjects review board clearance, data analysis, report generation
- Joint – study design, hypothesis generation, new exposure data collection, report completion

**Former employees:**

- NIOSH – all tasks
Major Findings (1)

Beryllium oxide ceramics plant:
- Raw materials received as beryllium oxide powder
- Processes to create ceramic products include:
  - Forming, firing, machining, lapping, packaging
- Survey was conducted in 1998
Major Findings (1)

Ceramics plant (continued):

- **Sensitization**: 10%
  - Same for long-term, short-term employees
- **CBD**: 3%
  - Higher for long-term employees
- **Process-related risks**:
  - Machining still elevated for long-term employees
  - Lapping, forming, firing, packaging (all)
- **Exposure-response relations**:
  - Suggested
Major Findings (2)

**Metal, oxide and alloy production facility:**
- Raw materials received as beryllium hydroxide powder
- Pure metal, beryllium oxide, various alloys (including copper, aluminum, nickel)
- Survey conducted in 1999
Major Findings (2)

Metal, oxide and alloy production facility (continued):

- Sensitization: 11%
  - Same for long-term, short-term employees
- CBD: 4%
  - Higher for long-term employees
Major Findings (3)

- **Copper-beryllium alloy facility:**
  - Receives strip and wire materials
  - Processes include:
    - Annealing, pickling, drawing, point and chamfer, straightening, rolling, slitting
  - Survey conducted in 2000 (first)
Major Findings (3)

Copper-beryllium alloy facility (continued):

- Sensitization: at least 7%
- CBD: 4%
- Process-related risks
  - All in rod and wire processes
  - Highest airborne beryllium in wire annealing & pickling
  - No statistical association with strip metal production, production support, administration
  - No office employees with sensitization or CBD
Major Findings (4)

Service and distribution centers:

- Receive copper-beryllium materials
  - As strip metal (two centers)
  - As rod, bar and tube (one center)
- Distribution of products to customers
- Limited finishing
  - Processes include: slitting, sawing, heat treating
Major Findings (4)

Service and distribution centers (continued):

- Prevalence of sensitization and CBD was low:
  - One employee with CBD (1 %, 1/88)
  - Worked in production areas, not in production job
- Beryllium air samples limited in number, but very low
- Results may be relevant for “downstream” users
Follow-up of Two Cohorts

Current and former workers

- 1992 ceramics plant cohort:
  - Over 10-year period, 15 % of non-sensitized developed sensitization
  - 2/3 of sensitized also had CBD (10 %)
  - Including 1992 survey cases, 18 % of original cohort were sensitized, 13 % had CBD

- 1993-94 metal, oxide and alloy facility cohort:
  - Data not fully compiled
Other NIOSH Research (1)

Estimating number of “downstream” users:

- Using data from US Occupational Safety and Health Administration
- As many as 134,000 US workers may be currently exposed
Other NIOSH Research (2)

- Laboratory research:
  - Dermal exposure studies
  - Genetically-engineered mouse
Other NIOSH Research (3)

Genetic research:
- \( HLA-DPB1^{\text{Glu69}} \): sensitized and CBD much more likely to be carrier; homozygotes at highest risk
- Cytokine SNPs
- Gene-environment interactions
Computational chemistry:

- Role of electrostatic potential of HLA- DPB1 alleles
Other Research with Brush Wellman (1)

Dermal exposure to beryllium:

- Intervention effectiveness – beryllium under latex gloves
- Dermal survey at beryllium-copper alloy plant:
  - Potential transfer from surfaces to skin
  - Cotton gloves, neck and face wipes, surface sampling, air sampling
Other Research with Brush Wellman (2)

What is the best way to measure exposure?

- Total mass concentration
  - Most historical data
  - Inconsistent exposure-response relations
- Particle size
- Particle number concentration
- Particle chemistry
- Particle surface area
- Dissolution rate
Longitudinal surveillance

- Brush Wellman implemented regular periodic testing for sensitization (BeLPT)
  - Workers hired after 2000: testing before starting work and at 3, 6, 12, and 24 months
  - Other workers: testing every three years

- NIOSH is continuing with follow-up of former workers
Program Strengths

- **Well-characterized study cohort**
  - Primary industry workers

- **Longitudinal surveillance**
  - Some workers enrolled since 1992

- **Airborne beryllium exposure**
  - Extensive historical data

- **Multidisciplinary approach**
  - Epidemiology, industrial hygiene, genetics, toxicology, computational chemistry
Program Limitations

- **Resources**
  - Limited

- **Longitudinal surveillance**
  - Follow-up takes time

- **Other populations**
  - Currently only working with primary industry employees
Summary

Evaluation of data from this company’s surveillance program has provided generalizeable information about:

- process-related risks,
- exposure-response patterns,
- exposures of interest, and
- burden of disease.