Farmer’s Lung Disease

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Our lungs are susceptible to damage caused by inhaled toxic materials and irritants because the surface area of our lungs exposed to air is so large and body’s need for oxygen so great.
Occupational Lung Hazards

- Lung hazards come in many forms
Respiratory Diseases in Agriculture

- Occupational asthma
- Asphyxiation
  - (gas/fumes in lungs)
Respiratory Diseases in Agriculture

- Lung cancer
- Organic Dust Toxic Syndrome (ODTS) - Common lung illness
- Chronic Obstructive Pulmonary (Lung) Disease - emphysema, bronchitis
- Farmer’s Lung - allergic reaction
## Hypersensitivity pneumonitis - microorganisms (1)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Source</th>
<th>Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer’s Lung</td>
<td>Hay, straw</td>
<td>Micropolyspora faeni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermoactinomycetes spp</td>
</tr>
<tr>
<td>Mushroom worker’s lung</td>
<td>Compost</td>
<td>Thermoactinomycetes spp</td>
</tr>
<tr>
<td>Woodworker’s lung</td>
<td>Wood pulp</td>
<td>Alternaria spp</td>
</tr>
<tr>
<td>Malt worker’s lung</td>
<td>Whiskey maltings</td>
<td>Aspergillus spp</td>
</tr>
<tr>
<td>Sequoiosis</td>
<td>Redwood</td>
<td>Aureobasidium pullulans</td>
</tr>
<tr>
<td>Bagassosis</td>
<td>Bagasse</td>
<td>Thermoactinomycetes spp</td>
</tr>
</tbody>
</table>
Hypersensitivity pneumonitis - microorganisms (2)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Source</th>
<th>Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewage worker’s lung</td>
<td>Sewage</td>
<td>Cephalosporium</td>
</tr>
<tr>
<td>Maple bark stripper’s lung</td>
<td>Maple</td>
<td>Cryptostroma corticale</td>
</tr>
<tr>
<td>Suberosis</td>
<td>Cork</td>
<td>Penicillium frequentens</td>
</tr>
<tr>
<td>Paprika splitter’s lung</td>
<td>Paprika</td>
<td>Mucor stolonifer</td>
</tr>
<tr>
<td>Detergent worker’s lung</td>
<td>Detergents</td>
<td>Bacillus subtilis</td>
</tr>
<tr>
<td>Humidifier lung</td>
<td>Water in humidifier</td>
<td>Thermophilic organisms</td>
</tr>
</tbody>
</table>
### Hypersensitivity pneumonitis – (3)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Source</th>
<th>Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animal source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat weevil lung</td>
<td>Grain dust</td>
<td>Sitophilus granaris</td>
</tr>
<tr>
<td>Pigeon breeder’s lung</td>
<td>Excreta</td>
<td>Pigeons</td>
</tr>
<tr>
<td>Furrier’s lung</td>
<td>Hair</td>
<td>Animal furs</td>
</tr>
<tr>
<td>Fish-meal worker’s lung</td>
<td>Meal</td>
<td>Fish</td>
</tr>
<tr>
<td>Rodent handler’s lung</td>
<td>Urinary protein</td>
<td>Rodents</td>
</tr>
<tr>
<td><strong>Plant source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee worker’s lung</td>
<td>Coffee bean</td>
<td>Coffee</td>
</tr>
<tr>
<td>Woodworker’s lung</td>
<td>Wood dust</td>
<td>Gonystylus bacanuss</td>
</tr>
</tbody>
</table>
HYPERSENSITIVITY PNEUMONITIS = EXTRINSIC ALLERGIC ALVEOLITIS

- Bird Keepers’ Lung = 83.4%
- Farmer’s Lung = 8.9%
- Mushroom alveolitis = 7.7%

Muller S. Z Gesamte Inn Med
1990 Oct; 45(19): 581-4
Hypersensitivity pneumonitis: Japanese Nationwide Epidemiological Study

- Total HP cases = 835 (653 definite, 182 probable)
- Occupational HP = 115 (13.8%)
- Farmer’s lung = 68 (59% of Occup. HP)
- Chemical HP = 19
- Antibody analysis and environmental challenge differences were notable; careful interview and an antigen panel match are the key to accurate diagnosis.

Yoshida et al, Occup Environ Med. 1995 Sep; 52(9): 750-4
Interstitial lung disease

- Early stage and acute is alveolitis (injury with inflammatory cell infiltration)
- Late stage characterised by fibrosis

Clinical effects due to hypoxia (respiratory failure) and cardiac failure
Chronic Interstitial Disease

- Idiopathic pulmonary fibrosis (IPF)
- Sarcoidosis
- Extrinsic allergic alveolitis (hypersensitivity pneumonitis)
- Pneumoconiosis
- Connective tissue diseases
Extrinsic allergic alveolitis (hypersensitivity pneumonitis)

- Chronic inflammatory disease
  - Small airways
  - Interstitium
  - Occasional granulomas

- Allergic origin
  - Type III hypersensitivity
  - Type IV hypersensitivity
Pulmonary interstitium

- Alveolar lining cells (types 1 and 2)

- Thin elastin-rich connective component containing capillary blood vessels
Inflammation in hypersensitivity pneumonitis
Grain Dust-Farmer’s Lungs
Etiology: Farmer’s Lung

*Streptomyces thermohygroscopicus* (EPST) is a thermoactinomycete which has been found to be related to Farmer’s Lung Disease

Dai HP. Chung Hua Chie Ho Ho Hu Hsi Tsa Chih. 1989 Oct; 12(5); 282-319
Etiology: Bagassosis

Thermoactinomyces sacchari

Boiron et al. Clin Allergy
1987 July; 17(4): 355-63
PATHOPHYSIOLOGY OF BAGASSOSIS

- Bagasse
- Actinomycete spores
- Granuloma
- Pneumonitis

Interstitial infiltration with lymphocytes and macrophages

Interstitial fibrosis

Zaidi et al. Environ Res 1983 Aug; 31(2) : 279-86
Immune Complexes
Complement activation
Plasminogen activator
Fibronectin
FGH
Collagen
Lymphokine

Basic Cationic Proteins
Eosinophils
Chemotactic Factors
Neutrophils
Collagenase
O₂ radicals

TISSUE DAMAGE
TYPES OF INJURY IN NON-MALIGNANT INTERSTITIAL LUNG DISEASE

- FIBROSIS
- DISTORTION
- DESTRUCTION
## Interstitial Lung Disorders of Known Etiology: Forms of Injury

<table>
<thead>
<tr>
<th></th>
<th>Distortion</th>
<th>Fibrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic dusts</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Organic dusts</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Gases</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Fumes</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Radiation</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Poisons</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
SYMPTOMS OF FIBROSIS

- DYSPNEA
- DRY, IRRITATING, AND PERSISTENT COUGH
- SUBSTERNAL DISCOMFORT
- ANOREXIA
- WEIGHT LOSS
- ARTHRALGIA

HIGH INDEX OF SUSPICION!!!
EAA: symptoms

- flu-like illness
- cough
- high fever, chills
- dyspnea, chest tightness
- malaise, myalgia
  4-8 hours after exposure
- chronic disease: dyspnea in strain, sputum production, fatigue, anorexia, weight loss
PHYSICAL SIGNS OF FIBROSIS

- TACHYPNEA
- LOWER LOBE FIBROSIS ---> FINE, END-INSPIRATORY CREPITATIONS, WHICH DISAPPEAR WITH POSITION
- FINGER CLUBBING
- CYANOSIS
Hypersensitivity pneumonitis (bagassosis) : Report of 5 cases

- Sex: all males
- Age range: 29 - 52 y.o.
- Work exposure: 1 in sugar mill; 4 in paper mill
- Length of exposure: 2 days to 15 years
- Common symptoms: cough, dyspnea, fever
- Chest x-ray: reticulonodular (3), reticular (1), and miliary nodular (1)
- BAL: predominantly lymphocytic
- ABG: hypoxemia
- PFT: restrictive
- DLco: decreased (43 - 78%)

Hur et al, Kao Hsiung I Hsueh Ko Hsueh Tse Chih 1994, Oct; 10(10) 558 - 64
Diagnosis

- Compatible clinical picture (symptoms, chest x-ray or CT, lung function changes) of HP
- Presence of precipitating antibodies
- Bronchoalveolar lavage
- Lung biopsy

Objective testing to establish work-relatedness:
- Returning to work induce similar symptoms and signs
- Specific challenge tests – more difficult to do.
Occupational hypersensitivity pneumonitis: diagnosis

Major Criteria (requires at least 2):

1. Symptoms compatible with hypersensitivity pneumonitis
2. Exposure to an antigen by history or detection of antibody in serum or bronchoalveolar lavage (BAL) fluid
3. Chest radiograph or HRCT with compatible findings
4. Lymphocytosis in lung lavage fluid if BAL is performed
5. Compatible histopathologic changes on lung biopsy, if biopsy is performed
6. Reproduction of symptoms and laboratory and lung function abnormalities after exposure to the suspect workplace

Minor Criteria:

1. Dyspnea on exertion
2. Bibasilar dry inspiratory crackles
3. Recurrent febrile episodes
4. Decreased lung diffusion capacity (DLCO)
5. Arterial hypoxemia at rest or with exercise
Diagnosis of Hypersensitivity pneumonitis

Chest x-ray

- Acute: Diffuse ground-glass infiltrates, nodular or striated patchy opacities. Up to 20% have normal CXR.
- Subacute: Same as acute, may have sparing of lung bases
- Chronic: Upper lobe fibrosis, reticular opacities, volume loss, honeycombing
- may be normal or show patchy or diffuse infiltrates or discrete nodular infiltrates. There may be honeycombing.
Mushroom Workers’ Lung
(Thermoactinomyces vulgaris)
Diagnosis of Hypersensitivity pneumonitis

CT scan

- is diagnostic showing the details of fibrosis, honeycombing and nodules.
Diagnosis of Hypersensitivity pneumonitis

**Pulmonary function test (PFT)**

shows a restrictive or obstructive pattern, decreased lung volume, impaired diffusion capacity, bronchial hyper reactivity and reversibility.

**Lung biopsy** through bronchoscopy may be diagnostic.

**Inhalation challenge** i.e. a positive response to inhaled antigen may be done for transient airflow obstruction.
Diffuse lymphocytic infiltration and clusters of epithelioid cells (arrows) in farmer's lung (hematoxylin-eosin staining; original magnification x300).
Pathology:

Granulomatous inflammation around the alveoli and the peripheral bronchioles.
Exudate with plasma cells and lymphocytes.
Macrophages, epitheloid cells and giant cells in the granulomas in the middle of the inflammation process.
After the exposure ceases the reaction disappears in 3-4 months.
Diagnosis: ELISA vs. CIE for detection of Ab against Thermoactinomyces sacchari

<table>
<thead>
<tr>
<th>Diagnostic Procedure</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELISA</td>
<td>82%</td>
<td>88%</td>
</tr>
<tr>
<td>CIE</td>
<td>60%</td>
<td>58%</td>
</tr>
</tbody>
</table>

Boiron et al, Clin Allergy 1987 July; 17(4): 355-63
Diagnosis of Hypersensitivity pneumonitis
Lab Tests

• May have increased **inflammatory markers** (erythrocyte sedimentation rate, C-reactive protein)
• Leukocytosis and increased gamma globulins typically seen
• Specific IgG antibody to offending agent can be detected and checked serially to detect response to treatment

Not always present (likely because many unknown antigens)
Low specificity (10% of people exposed to farmer’s lung antigen develop antibodies; only 0.3% show symptoms)
• Rheumatoid factor often positive (unknown cause)
• Negative blood, sputum, throat cultures
Diagnosis of Hypersensitivity pneumonitis

Lab Tests

• Bronchoalveolar lavage (BAL)
  - Acute form with neutrophils and CD4 T lymphocytes
  - Chronic form with high number of CD8 T lymphocytes
  - BAL may help to differentiate chronic hypersensitivity pneumonitis from sarcoid, which has high CD8 T lymphocytes
  - Neutrophilia, lymphopenia, increased ESR, C reactive protein, rheumatoid factor, raised serum immunoglobulins.
### Table 1. Sensitivity and specificity of serological tests (electrosynneresis and double diffusion) with the four antigens

<table>
<thead>
<tr>
<th>Antigen</th>
<th>Area under the ROC curve (SD)</th>
<th>Selected threshold</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
<th>LR +*</th>
<th>Odds ratio (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrosynneresis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. corymbifera</td>
<td>0.944 (0.045)</td>
<td>2 arcs</td>
<td>86.7 (59.5–98.0)</td>
<td>100 (100–100)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E. amstelodami</td>
<td>0.871 (0.067)</td>
<td>3 arcs</td>
<td>66.7 (38.4–88.1)</td>
<td>100 (100–100)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>W. sebi</td>
<td>0.687 (0.098)</td>
<td>2 arcs</td>
<td>46.7 (21.3–73.4)</td>
<td>93.3 (68.0–98.9)</td>
<td>7.00</td>
<td>12.25 (1.69–88.94)</td>
</tr>
<tr>
<td>S. rectivirgula</td>
<td>0.756 (0.090)</td>
<td>2 arcs</td>
<td>46.7 (21.3–73.4)</td>
<td>93.3 (68.0–98.9)</td>
<td>7.00</td>
<td>5.69 (1.03–31.46)</td>
</tr>
<tr>
<td><strong>Double diffusion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. corymbifera</td>
<td>0.813 (0.080)</td>
<td>1 arc</td>
<td>73.3 (44.9–92.0)</td>
<td>93.3 (68.0–98.9)</td>
<td>11.00</td>
<td>38.5 (5.64–262.60)</td>
</tr>
<tr>
<td>E. amstelodami</td>
<td>0.713 (0.095)</td>
<td>1 arc</td>
<td>53.3 (26.6–78.7)</td>
<td>86.7 (59.5–98.0)</td>
<td>4.00</td>
<td>7.43 (1.37–40.32)</td>
</tr>
<tr>
<td>W. sebi</td>
<td>0.687 (0.098)</td>
<td>1 arc</td>
<td>73.3 (44.9–92.0)</td>
<td>60.0 (32.3–83.6)</td>
<td>1.83</td>
<td>4.12 (0.91–18.63)</td>
</tr>
<tr>
<td>S. rectivirgula</td>
<td>0.698 (0.097)</td>
<td>1 arc</td>
<td>66.7 (38.4–88.1)</td>
<td>66.7 (38.4–88.1)</td>
<td>2.00</td>
<td>4 (0.9–17.72)</td>
</tr>
</tbody>
</table>

*LR +, Positive likelihood ratio.*
Table 2. Sensitivity and specificity of serological tests (ELISA IgG and IgA) with the four antigens

<table>
<thead>
<tr>
<th>Antigen</th>
<th>Area under the ROC curve (SD)</th>
<th>Selected threshold</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
<th>LR +*</th>
<th>Odds ratio (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELISA IgG†</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><em>A. corymbifera</em></td>
<td>0.633 (0.103)</td>
<td>&gt;214†</td>
<td>46.7 (21.3–73.4)</td>
<td>86.7 (59.5–98.0)</td>
<td>3.50</td>
<td>5.69 (1.03–31.46)</td>
</tr>
<tr>
<td><em>E. amstelodami</em></td>
<td>0.620 (0.103)</td>
<td>&gt;534†</td>
<td>46.7 (21.3–73.4)</td>
<td>86.7 (59.5–98.0)</td>
<td>3.50</td>
<td>3.79 (0.79–18.26)</td>
</tr>
<tr>
<td><em>W. sebi</em></td>
<td>0.758 (0.089)</td>
<td>&gt;195†</td>
<td>60.0 (32.3–83.6)</td>
<td>93.3 (68.0–98.8)</td>
<td>9.00</td>
<td>21 (3.06–144.09)</td>
</tr>
<tr>
<td><em>S. rectivirgula</em></td>
<td>0.624 (0.103)</td>
<td>&gt;153†</td>
<td>86.7 (59.5–98.0)</td>
<td>40.0 (16.4–67.7)</td>
<td>1.44</td>
<td>4.33 (0.76–24.70)</td>
</tr>
<tr>
<td><strong>ELISA IgA†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. corymbifera</em></td>
<td>0.638 (0.102)</td>
<td>≤104†</td>
<td>53.3 (26.6–78.7)</td>
<td>80.0 (51.9–95.4)</td>
<td>2.67</td>
<td>4.57 (0.95–22.03)</td>
</tr>
<tr>
<td><em>E. amstelodami</em></td>
<td>0.644 (0.100)</td>
<td>≤19†</td>
<td>33.3 (11.9–61.6)</td>
<td>93.3 (68.0–98.9)</td>
<td>5.00</td>
<td>7 (0.87–56.54)</td>
</tr>
<tr>
<td><em>W. sebi</em></td>
<td>0.522 (0.107)</td>
<td>&gt;256†</td>
<td>40.0 (16.4–67.7)</td>
<td>86.7 (59.5–98.0)</td>
<td>3.00</td>
<td>4.33 (0.76–24.70)</td>
</tr>
<tr>
<td><em>S. rectivirgula</em></td>
<td>0.547 (0.107)</td>
<td>≤44†</td>
<td>33.3 (11.9–61.6)</td>
<td>93.3 (68.0–98.9)</td>
<td>5.00</td>
<td>7 (0.87–56.54)</td>
</tr>
</tbody>
</table>

*LR+, Positive likelihood ratio.
†Absorbance.
## Differential diagnosis of occupational hypersensitivity pneumonitis

<table>
<thead>
<tr>
<th>Acute Form</th>
<th>Disorder</th>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming</td>
<td>Silo unloader’s disease</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>Organic dust toxic syndrome</td>
<td>Humidifier fever, animal house fever, grain fever, pulmonary mycotoxicosis</td>
<td>Endotoxin, mycotoxin</td>
</tr>
<tr>
<td>Inorganic dust toxic syndrome</td>
<td>Acute berylliosis</td>
<td>Beryllium dust: aerospace, nuclear, ceramics, dental</td>
</tr>
<tr>
<td>Textile dust</td>
<td>Byssinosis</td>
<td>Cotton dust and endotoxin</td>
</tr>
<tr>
<td></td>
<td>Mill fever</td>
<td>Tannins in cotton mill dust, kapok</td>
</tr>
<tr>
<td></td>
<td>Weaver’s cough</td>
<td>Tamarind seed powder</td>
</tr>
<tr>
<td>Bird raising</td>
<td>Psittacosis</td>
<td><em>Chlamydia psittaci</em> infection</td>
</tr>
</tbody>
</table>

*Immunol Allergy Clin N Am 31 (2011) 769–786*
# Differential diagnosis of occupational hypersensitivity pneumonitis

## Chronic Form

<table>
<thead>
<tr>
<th>Inorganic respiratory dust syndromes</th>
<th>Silicosis and siderosis</th>
<th>Silica in mining, quarrying, drilling, foundry working, ceramics manufacturing, sandblasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic berylliosis</td>
<td>Beryllium dust -aerospace, nuclear, ceramics, dental</td>
<td></td>
</tr>
<tr>
<td>Asbestosis</td>
<td>Fibrous silicate minerals (e.g., chrysotile)</td>
<td></td>
</tr>
<tr>
<td>Coal worker’s pneumoconiosis</td>
<td>Mixed dust consisting of coal, kaolin, mica</td>
<td></td>
</tr>
<tr>
<td>Talcosis and calcificosis</td>
<td>Leather, ceramic, paper, plastics, rubber, building, paint, or cosmetic industries; limestone dust</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food industry</th>
<th>Flavor-worker’s lung</th>
<th>Diacetyl butter flavor ketone in microwave popcorn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rice-miller’s syndrome</td>
<td>Rice husk dust containing silica</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Textile dust</th>
<th>Byssinosis</th>
<th>Cotton, hemp, flax, jute, sisal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nylon flock</td>
<td>Pulverized fibers applied to fabrics</td>
</tr>
<tr>
<td></td>
<td>Ardystil syndrome</td>
<td>Acramin-FWN (a polyamidoamine)</td>
</tr>
</tbody>
</table>

| Lifeguards                          | Lifeguard lung        | Trichloramine and/or endotoxin |

| Office buildings                    | Sick building syndrome | VOC, smoke, poor ventilation, dampness |
Treatment of Hypersensitivity pneumonitis

The condition should be diagnosed by occupational history, lifestyle, livelihood, *Hlo* exposure to antigens.

The exposure should be checked by wearing of appropriate masks, pollen masks, personal dust respirators, air helmets, ventilated helmets with fresh air.

Avoidance of offending antigen is primary therapy.

**Corticosteroids**

- Prednisone: 1–2 mg/kg/day, to max of 50–60 mg p.o. daily
- Initial course of 1–2 weeks with progressive taper
- Low-dose therapy (20 mg p.o. daily) may be as effective as avoidance

- Maintenance dose may be continued at the lowest possible dosage if symptoms recur
EAA: prognosis

Continuing exposure, relapsing disease leads to pulmonary fibrosis, permanent loss of pulmonary function and cor pulmonale.

When Finnish cases with farmer's lung were followed for 10 years, 23% had findings of pulmonary emphysema or pulmonary fibrosis.
EAA: prevention

- reduction of dust exposure
- work hygienic improvements
- adequate respirators always during exposure before any symptoms!
- occupational health care:
  – information
  – follow-up
  – finding symptomatic workers in time, to prevent permanent loss of pulmonary function.
Occupational Lung Health Monitoring

Questionnaires

Chest x-rays

‘Fitness to wear’ respirator testing

Lung function tests (spirometry)
Annual Lung Function Tests

- Grain Industry Workers
- Industry Workers in livestock confinement buildings
- Workers who smoke
- Dairy farmers
- People with history of bronchitis, asthma or frequent lung infections
Conclusion

Farmer’s lung is the most usual form of extrinsic allergic alveolitis. Chronic form leads to severe disability.

Reduction of the exposure to biological dust by work hygienic improvements and using adequate respirators is important. The humidifiers and other sources of exposure should be cleaned.

Early recognition of the symptoms is essential.

ODTS is a milder syndrome, symptoms can be prevented using respirator when exposed.
MARAMING SALAMAT PO!