

Health Concerns Associated with Mold in Water

by CDC

Damaged Homes After Hurricanes Katrina and Rita

New Orleans Area, Louisiana— After Hurricanes Katrina and Rita made landfall on August 29 and September 24, 2005, respectively, large sections of New Orleans (Orleans Parish) and the three surrounding parishes (Jefferson, Plaquemines, and St. Bernard) were flooded for weeks, leading to extensive mold growth in buildings. As residents reoccupied the city, local health-care providers and public health authorities were concerned about the potential for respiratory health effects from exposure to water-damaged homes. On October 6, CDC was invited by the Louisiana Department of Health and Hospitals (LDHH) to assist in documenting the extent of potential exposures. This report summarizes the results of that investigation, which determined that 46% of inspected homes had visible mold growth and that residents and remediation workers did not consistently use appropriate respiratory protection. Public health interventions should emphasize the importance of safe remediation practices and ensure the availability of recommended personal protective equipment.

Housing Assessment for Mold and Mold Exposure During October 22--28, a team representing CDC and LDHH assessed a cross-section of the

440,269 households in the four-parish area (on the basis of the 2000 U.S. Census). Sampling was restricted to blocks with more than 20 housing units (areas with fewer housing units are likely to be sparsely populated and to contain mostly industrial buildings or parks) and areas where residents were permitted entry, yielding 239,949 potential households (Figure).

Blocks were classified into three strata (mild, moderate, and severe) on the basis of Federal Emergency Management Agency flood and damage maps. Geographic information system (GIS) mapping software was used to select a random number of waypoints (latitude and longitude) proportionate for each stratum (1). A sample size of 88 homes was required to obtain estimates within 10% accuracy. Global positioning system (GPS) units were used to locate each waypoint as the random starting point to locate the nearest home at or north of the waypoint.

In the sampled areas, 141 homes were found to be

occupied. A questionnaire on demographics, home occupancy, and participation in remediation activities was administered to one consenting adult from 113 of the 141 homes in which someone was in the home. One assessment was abandoned for safety reasons, resulting in a final sample of 112. A standard instrument designed for this study and pilot-tested with occupants of flood-damaged homes

was used to visually assess water damage and mold growth. Air samples were collected at a subset of 20 homes; samples were collected for 36--144 minutes with 0.4 μm , 37 mm polycarbonate closed-faced cassettes at 3 L/min. The filters were analyzed for culturable fungi, (1@3,1@6)-b-D-glucan (a cell-wall component of many fungi) (2), and endotoxin (a cell-wall component of gram-negative bacteria) (3).

Of 112 homes inspected (Table on next page), flood levels had been

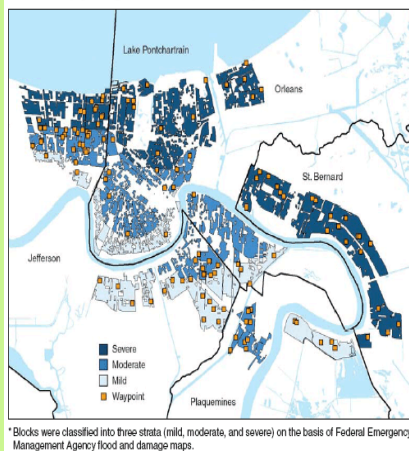
high (>6 feet) in 21 (18.8%) homes, medium (3--6 feet) in 19 (17.0%), and low (<3 feet) in 72 (64.3%) (including 44 [39.3%] homes with no flooding). Seventy-six (67.9%) homes had roof damage with water leakage. Visible mold growth occurred in 51 (45.5%) homes, and 19 (17.0%) had heavy mold coverage (>50% coverage on interior wall of most-affected room). The distribution of homes with heavy mold coverage was 10 (52.6%), seven (36.8%), and two (10.5%) in high, medium, and low flood areas, respectively.

Participants reported being indoors doing heavy cleaning an average of 13 hours since the hurricanes (range: 0--84 hours) and 15 hours doing light cleaning (range: 0--90 hours). Sixty-eight (60.7%) participants reported inhabiting their homes overnight for an average of 25 (standard deviation: ± 13.7) nights since the hurricanes.

Indoor air samples were collected nonrandomly at 20 (16%) homes; outdoor air samples were also collected for 11 of these homes. Predominant fungi indoors and outdoors were *As*

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FIGURE. Map of four-parish area with three-strata sampling area used for housing assessments, by damage level* — New Orleans area, Louisiana, October 2005



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TABLE. Flood level, roof damage, and visible mold growth observed in 112 inspected homes — New Orleans area, Louisiana, October 2005

	No. ^a	(%)
Flood level		
Low (<3 feet) [†]	72	(64.3)
Medium (3–6 feet)	19	(17.0)
High (>6 feet)	21	(18.8)
Roof damage with water leakage	76	(67.9)
Visible mold growth	51	(45.5)
Heavy [‡]	19	(17.0)
Low flood level	2	(1.8)
Medium flood level	7	(6.3)
High flood level	10	(8.9)

^a Denominators ranged from 108 to 112 because of incomplete data.

[†] Includes 44 homes (39%) without any flooding.

[‡] Defined as >50% mold coverage on interior wall of most-affected room.

pergillus spp. and *Penicillium* spp. Geometric mean (1@3,1@6)-b-D-glucan air levels were 1.6 $\mu\text{g}/\text{m}^3$ (geometric standard deviation [GSD]: 4.4) indoors and 0.9 $\mu\text{g}/\text{m}^3$ (GSD: 2.0) outdoors; endotoxin levels were 23.3 EU/ m^3 (GSD: 5.6) indoors and 10.5 EU/ m^3 (GSD: 2.5) outdoors. Glucan and endotoxin levels were significantly correlated (correlation coefficient $r = 0.56$; $p = 0.0095$). The geometric mean glucan and endotoxin levels were higher indoors compared with outdoors but the differences were not statistically significant.

Survey of Residents and Workers Regarding Mold During October 18--23, the assessment team conducted interviews with residents and remediation workers in recently flooded communities at three sites (i.e., the FEMA Disaster Recovery Center in St. Bernard, a home improvement store in West Jefferson, and a grocery store in East Jefferson)

and at worker gathering places (e.g., work sites, campsites, and social venues). A convenience sample of residents and remediation workers with potential exposure to mold were asked questions about their knowledge, attitudes, and practices regarding mold; nonidentifying demographic information was also collected. A total of 332 persons (workers and residents combined) were approached for interviews; 235 (70.1%) participated. Interviews were conducted in English and Spanish. A display of respirators was used for reference during the interviews.

Of 159 residents interviewed, 82 (51.6%) were male; the overall mean age was 51 years (range: 18--81 years). Nearly all (96.2%) residents responded affirmatively to the question, "Do you think mold can make people sick?" One hundred eight (67.9%) correctly identified particulate-filter respirators as appropriate respiratory protection for cleaning of mold. Sixty-seven (42.1%) had cleaned up mold; of these, 46 (68.7%) did not always use appropriate respirators. Reasons for not using respirators included discomfort (10 [21.7%] respondents) and lack of availability (10 [21.7%]). For public communications about potential risks from exposure to mold and the use of personal protective equip-

ment, 139 (87.4%) respondents recommended the use of television or radio.

Seventy-six persons who self-identified as remediation workers were interviewed. Of these, 14 (18.4%) were self-employed, and 62 (81.6%) worked for a company doing remediation. Of the 76 workers, 70 (92.1%) were male; the mean age of respondents was 33 years (range: 18--57 years); 40 (52.6%) spoke only Spanish. Seventy-two (94.7%) thought mold causes illness. Sixty-five (85.5%) correctly identified particulate-filter respirators as appropriate protection for cleaning of mold. Sixty-nine (90.7%) had already participated in mold remediation activities at the time of the interview. Of these, 34 (49.3%) had not been fit tested for respirator use and 24 (34.8%) did not always use appropriate respirators; 13 (54.2%) cited discomfort as the reason for not using respirators.

For worker communications about potential risks from exposure to mold and the use of personal protective equipment, 36 (47.4%) recommended use of television or radio and 17 (22.4%) recommended communication through employers.

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