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Hurricane-Associated Mold Exposures Among Patients at Risk for Invasive Mold Infections After Hurricane Harvey — Houston, Texas, 2017

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In August 2017, Hurricane Harvey caused unprecedented flooding and devastation to the Houston metropolitan area (*1*). Mold exposure was a serious concern because investigations after Hurricanes Katrina and Rita (2005) had documented extensive mold growth in flood-damaged homes (*2*,*3*). Because mold exposure can cause serious illnesses known as invasive mold infections (*4*,*5*), and immunosuppressed persons are at high risk for these infections (*6*,*7*), several federal agencies recommend that immunosuppressed persons avoid mold-contaminated sites (*8*,*9*). To assess the extent of exposure to mold and flood-damaged areas among persons at high risk for invasive mold infections after Hurricane Harvey, CDC and Texas health officials conducted a survey among 103 immunosuppressed residents in Houston. Approximately half of the participants (50) engaged in cleanup of mold and water-damaged areas; these activities included heavy cleanup (23), such as removing furniture or removing drywall, or light cleanup (27), such as wiping down walls or retrieving personal items. Among immunosuppressed persons who performed heavy cleanup, 43% reported wearing a respirator, as did 8% who performed light cleanup. One participant reported wearing all personal protective equipment (PPE) recommended for otherwise healthy persons (i.e., respirator, boots, goggles, and gloves). Immunosuppressed residents who are at high risk for invasive mold infections were exposed to mold and flood-damaged areas after Hurricane Harvey; recommendations from health care providers to avoid exposure to mold and flood-damaged areas could mitigate the risk to immunosuppressed persons.

Interviews were conducted with a convenience sample of immunosuppressed residents from three hospital systems in the Houston metropolitan area. Eligible residents were selected because of risk factors for invasive mold infections (*7*); participants included persons who had received a solid organ transplant in the past year or who had been prescribed an immunosuppressive medication, including tumor necrosis factor inhibitors, cyclosporine, or chemotherapeutic agents, in the last 3 months. Models developed by CDC's Geospatial Research, Analysis and Services Program were used to predict whether residents' homes had been flooded. Residents whose homes were predicted to have been flooded were prioritized for contact.

Among the three hospital systems from which participants were selected, systematic, hospital-wide messaging about avoiding mold exposure had not been disseminated before Hurricane Harvey. A CDC questionnaire developed after Hurricanes Katrina and Rita was modified and field-tested. Questions

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were focused on experiences with housing, flooding and mold, cleanup activities, and PPE. Cleanup was categorized as either heavy (e.g., removing furniture, drywall, or carpeting) or light (e.g., sweeping, wiping off counters or walls, or retrieving personal items). The 20-minute questionnaire was administered by telephone in either English or Spanish by trained interviewers during October 21–November 8, 2017; no personally identifiable information was collected. Interviewers were trained on types of PPE. Federal agency–developed materials on how residents who are not immunosuppressed can safely conduct mold cleanup after disasters were made available to participants after the interview. Because this work was part of an ongoing public health response, it was determined to be nonresearch public health practice by CDC's Human Research Protection Office and the local hospitals and thus was not subject to institutional review board review.

Interviewers attempted to contact 800 immunosuppressed persons, and 167 (21%) were reached, 109 (65%) of whom consented to be interviewed. Among these 109 persons, 103 (94%) had stayed within the Houston metropolitan area during Hurricane Harvey (August 25–August 29, 2017) or in the months afterwards (August 30–interview date); the survey sample consisted of these 103 persons. During the hurricane, 77 (75%) reported staying at home for the majority of the time, 20 (19%) stayed at friends or relatives' homes, and seven (7%) stayed at other places, including hotels, hospitals, shelters, or nursing homes (Table 1). In contrast, since the hurricane, 83 (81%) stayed at home, 12 (12%) stayed at friends or relatives' homes, and six (6%) stayed at other places. Of the 102 participants whose responses were available, 92 (89%) reported living in their homes at the time of the interview; of the 10 who did not, eight had been back to their homes. One participant's response was not available.

Forty-six (45%) respondents reported that water had entered their homes, 37 (80%) of whom reported that the first floor living space was flooded with a median of 3 inches of water (interquartile range [IQR] = 1–12 inches) for a median of 3 days (IQR = 1–4 days) (Table 2). Among the 37 respondents who reported water in their living space, 28 (76%) reported seeing or smelling mold inside the home after the hurricane, and 32 (86%) had their home cleaned for water damage or remediated for mold. Seventeen (53%) participants lived in the house during cleanup, and 17 (53%) performed the cleanup themselves. In addition, 23 (62%) reported plans for cleanup or remediation within the next 6 months.

Participation in cleanup activities for any home was assessed among all 103 survey respondents; overall, 50 (49%) engaged in any cleanup activities, including 23 (22%) who engaged in heavy cleanup activities for a median of 7 days (IQR = 5–14 days) and 27 (26%) who participated in only light cleanup activities for a median of 4 days (IQR = 2–14 days) (Table 3). Among the 23 participants who engaged in heavy cleanup activities, 10 (43%) wore a full-face, half-face, or N-95 respirator,* half of whom reported always wearing a respirator

* The N95 respirator is the most common particulate-filtering facepiece respirator and filters at least 95% of airborne particles. https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/n95list1.html.

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TABLE 1. Housing status of immunosuppressed survey participants (N = 103) who reported staying in the Houston metropolitan area before or since Hurricane Harvey — Houston, Texas, August–November 2018

Housing status	No. (%)
During Hurricane Harvey*	
Home	77 (75)
Friends or relatives	20 (19)
Other†	7 (7)
Since Hurricane Harvey*	
Home	83 (81)
Friends or relatives	12 (12)
Other†	6 (6)
Currently living at home	
Yes	92 (89)
No	10 (10)
Reentered home	8 (80)
Did not reenter home	2 (20)
Response not available	1 (1)

* Participants might have provided more than one response or provided a response not shown in the options given; thus, the subtotals do not sum to 103.
† Hospital, hotel, nursing home, or shelter.

TABLE 2. Flooding, mold, and cleanup experiences of immunosuppressed survey respondents who reported water entry into the first floor living space after Hurricane Harvey (N = 37) — Houston, Texas, August–November 2018

Experiences and plans	No. (%)
Saw or smelled mold	
Yes	28 (76)
No	8 (22)
Don't know	1 (3)
Cleaned or remediated home	
Yes	32 (86)
Lived in home during cleanup	17 (53)
Did not live in home during cleanup	15 (47)
Who completed the cleanup*	
Self	17 (53)
Friends or family	12 (38)
Professional remediation	15 (47)
No	5 (14)
Plans for cleaning or remediation within 6 mos	
Yes	23 (62)
No	11 (30)
Don't know	3 (8)

* Participants might have provided more than one response; thus, the subtotals do not sum to 32.

during cleanup. Eighteen participants wore gloves during heavy cleanup, eight wore boots, and two wore goggles. Three participants reported using no PPE. Among the 27 participants who engaged in light cleanup activities, two wore a respirator, both of whom reported wearing it at all times during cleanup. Thirteen wore gloves, two used goggles, and one wore boots; seven used no PPE. Among all participants who engaged in cleanup activities, only one wore all PPE recommended for otherwise healthy persons.

Among all 103 participants, 62 (60%) reported hearing or reading about what to wear to clean up mold and floodwater.

TABLE 3. Time spent in cleanup activities and use of personal protective equipment (PPE) during cleanup among immunosuppressed respondents who stayed in Houston during and after Hurricane Harvey (N = 103) — Houston, Texas, August–November 2018

Time spent cleaning up and PPE use	Heavy cleanup* (n = 23) No. (%)	Light cleanup† (n = 27) No. (%)	Total (n = 50) No. (%)
Hrs per day engaged in cleanup			
<1	0 (0)	13 (48)	**13 (26)**
1–4	8 (35)	9 (33)	**17 (34)**
5–7	9 (39)	0 (0)	**9 (18)**
≥8	6 (26)	5 (19)	**11 (22)**
Wore a mask§			
Always	5 (22)	2 (7)	**7 (14)**
Most of the time	1 (4)	0 (0)	**1 (2)**
Less than half of the time	4 (17)	0 (0)	**4 (8)**
No	13 (57)	23 (85)	**36 (72)**
Missing information	0 (0)	2 (7)	**2 (4)**
Wore boots			
Yes	8 (35)	1 (4)	**9 (18)**
No	15 (65)	26 (96)	**41 (82)**
Wore gloves			
Yes	18 (78)	13 (48)	**31 (62)**
No	5 (22)	14 (52)	**19 (38)**
Wore goggles			
Yes	2 (9)	2 (7)	**4 (8)**
No	21 (91)	25 (93)	**46 (92)**
Wore any PPE			
Yes	20 (87)	20 (74)	**40 (80)**
No	3 (13)	7 (26)	**10 (20)**

* For example, removing furniture, drywall, or carpeting.
† For example, sweeping, wiping off counters or walls, or retrieving personal items.
§ Mask includes full-face respirator, half-face respirator, or N-95 respirator.

The most commonly reported information sources included television (14), word of mouth (14), and health care providers (seven). No participants reported obtaining information from social media or a website.

Discussion

This investigation of mold exposures and PPE use after Hurricane Harvey found that a convenience sample of immunosuppressed adult residents were exposed to mold and water-damaged areas. Immunosuppressed persons are at risk for invasive mold infections (primarily respiratory) with mortality rates as high as 50% (*6*). Although federal agencies recommend that immunosuppressed persons avoid flooded and mold-contaminated buildings (*9*), approximately half of survey participants engaged in cleanup activities, with approximately half of those who engaged in heavy cleanup and most of those engaged in light cleanup reporting not wearing respiratory protection; gloves were the most frequently reported PPE used.

In disaster settings such as Hurricane Harvey, immunosuppressed residents might experience difficulty in adhering to recommendations about avoiding mold-contaminated sites if the majority of homes in the community are affected. In such cases, proper use of an appropriate respirator and other PPE during reentry to the home might reduce mold exposure.

No participants reported websites or social media as sources of information about what one should wear during cleanup of mold and floodwater. This could reflect a unique demographic profile in this group; however, the profile could not be assessed because demographic information was not obtained as part of the survey.

The findings in this report are subject to at least three limitations. First, survey participants were not representative of all immunosuppressed patients in the Houston area because the participants consisted of a convenience sample of patients with specific conditions from three hospital systems. Although these findings cannot be extrapolated to all immunosuppressed residents in the Houston area during and after Hurricane Harvey, they suggest that a substantial number of immunosuppressed persons were exposed to mold and flood-damaged areas and that PPE use among some immunosuppressed persons who engaged in cleanup activities was low. Second, although it was ascertained that the three hospital systems had not conducted systematic, hospital-wide messaging about avoiding mold exposure before Hurricane Harvey, survey participants were not asked whether they had been told by a health care provider to avoid exposure to mold. Thus, it was not possible to determine whether survey participants who were exposed to mold were aware of federal recommendations. Finally, eligibility criteria included immunosuppressive medications for health conditions of varying severity, and information on specific conditions was not collected. For example, some participants were prescribed a tumor necrosis factor inhibitor for rheumatoid arthritis, whereas others received cyclosporine for a solid organ transplant. It is possible that immunosuppressed persons in better physical health were more likely to consent to the survey. As a result, these findings might overestimate the percentage of immunosuppressed persons performing cleanup activities.

Among a sample of immunosuppressed Houston area residents, many were exposed to mold and flood-damaged homes after Hurricane Harvey. Many residents at high risk for invasive mold infections engaged in activities to clean up mold and flood-damaged areas without wearing PPE recommended for otherwise healthy persons. Although recommendations for immunosuppressed persons are to avoid mold-contaminated sites, these findings might help prompt future studies on the knowledge, attitudes, and practices of PPE use among immunosuppressed persons in posthurricane settings and other locations experiencing flooding when complete avoidance of mold-contaminated sites is difficult. In turn, these studies could help inform future decisions about PPE recommendations for this population.

Summary

What is already known about this topic?

Immunosuppressed persons are at risk for invasive mold infections and should avoid exposures such as those present during hurricane and flood cleanup activities.

What is added by this report?

Among a convenience sample of immunosuppressed residents in the Hurricane Harvey-affected area of Houston, Texas, 49% engaged in cleanup activities in water-damaged or mold-contaminated homes. Use of respiratory protection was low.

What are the implications for public health practice?

Health care providers should advise immunosuppressed persons to avoid exposure to water-damaged and mold-contaminated areas to reduce their risk for invasive mold infections.

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Scaling Up Testing for Human Immunodeficiency Virus Infection Among Contacts of Index Patients — 20 Countries, 2016–2018

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In 2017, the Joint United Nations Programme on HIV/AIDS (UNAIDS) estimated that worldwide, 36.9 million persons were living with human immunodeficiency virus (HIV) infection, the virus infection that causes acquired immunodeficiency syndrome (AIDS). Among persons with HIV infection, approximately 75% were aware of their HIV status, leaving 9.4 million persons with undiagnosed infection (*1*). Index testing, also known as partner notification or contact tracing, is an effective case-finding strategy that targets the exposed contacts of HIV-positive persons for HIV testing services. This report summarizes data from HIV tests using index testing in 20 countries supported by CDC through the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) during October 1, 2016–March 31, 2018. During this 18-month period, 1,700,998 HIV tests with 99,201 (5.8%) positive results were reported using index testing. The positivity rate for index testing was 9.8% among persons aged ≥15 years and 1.5% among persons aged <15 years. During the reporting period, HIV positivity increased 64% among persons aged ≥15 years (from 7.6% to 12.5%) and 67% among persons aged <15 years (from 1.2% to 2.0%). Expanding index testing services could help increase the number of persons with HIV infection who know their status, are initiated onto antiretroviral treatment, and consequently reduce the number of persons who can transmit the virus.

To end the HIV epidemic by 2020, UNAIDS set multiple targets, including increasing to 90% the percentage of persons with HIV infection who knew their HIV status (*2*). Results from population-based HIV impact assessments in 10 African countries indicated that, as of 2018, the percentage of persons with HIV infection who knew their status ranged from 37% in Côte d'Ivoire to 86% in Namibia (*3*).

Since 2003, PEPFAR has provided approximately $72 billion to implement HIV testing and treatment programs in 37 countries and regions with high HIV prevalence (*4*). PEPFAR funds are administered through multiple U.S. governmental agencies, including CDC, that support international and local organizations and governments for HIV-related program implementation. In 2017, PEPFAR supported 85.5 million HIV rapid tests and linked 14 million adults and children to antiretroviral treatment (*5*).

Because HIV testing service resources from donors and governments are scarce, targeted strategies are needed to reach persons with undiagnosed HIV infection. In index testing, also known as partner notification or contact tracing, HIV-positive index patients voluntarily identify their sexual and needle-sharing partners and biologic children. Partners and children of index patients, who might have been exposed to HIV, are then contacted by the index patient or the provider, and those whose HIV infection status is not known are offered HIV testing services. Studies have demonstrated the effectiveness and cost-effectiveness of index testing as a strategy for identifying HIV-positive adults and children (*6*–*9*).

HIV program implementing partners supported by PEPFAR collect and report data for performance monitoring and evaluation purposes on a quarterly basis in accordance with the U.S. fiscal year (October 1–September 30). The primary HIV testing indicator is the number of persons who have received HIV testing services, categorized by HIV result, age group, sex, and testing service delivery approach. Age group categories are classified as <1 year, 1–9 years, 10–14 years, 15–19 years, 20–24 years, 25–49 years, and ≥50 years. Sex is not reported for children aged <10 years. Delivery approaches for HIV testing services include 1) community-based testing in mobile clinics; 2) voluntary drop-in centers; 3) facility-based provider-initiated testing in tuberculosis, sexually transmitted infection, outpatient, and antenatal clinics; 4) testing in hospital emergency and inpatient departments; and 5) since October 1, 2016, index testing.

This report includes the six most recent fiscal quarters for which index testing data were available (October 1, 2016–March 31, 2018). Among 33 countries reporting index testing data during this period, seven countries (Angola, China, Dominican Republic, El Salvador, Guyana, Honduras, and Thailand) that reported <1,000 persons tested using index testing and four countries (India, Kazakhstan, Kyrgyzstan, and Tajikistan) that reported <500 tests during October 1, 2017–March 31, 2018 were excluded from this analysis. Also excluded were Nigeria and Ukraine in response to requests from the country offices. The number of HIV tests reported using index testing and the percentage of positive tests among different demographic groups in CDC-supported PEPFAR programs in 20 countries* were summarized for this report.

From October 1, 2016, to March 31, 2018, CDC-supported implementing partners reported a total of 1,700,998 persons tested for HIV using index testing among the 20 countries evaluated, including 889,599 (52%) persons aged ≥15 years and 799,976 persons aged <15 years (Table 1). Overall, 99,201 (5.8%) persons were reported as HIV-positive, including 87,266 persons aged ≥15 years and 11,814 persons aged <15 years. Index testing from three countries (Kenya, Mozambique, and Tanzania) accounted for more than half of all HIV tests and positive results reported. By age group, 9.8% of HIV test results among persons aged ≥15 years and 1.5% among persons aged <15 years were positive. The rate of HIV positivity by country ranged from 0.7% to 24.5% among persons aged <15 years and from 2.8% to 29.1% among persons aged ≥15 years.

* Botswana, Cameroon, Côte d'Ivoire, Democratic Republic of the Congo, Eswatini, Ethiopia, Haiti, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, South Sudan, Tanzania, Uganda, Vietnam, Zambia, and Zimbabwe.

During the six fiscal quarters covered by this report, the number of persons tested for HIV using index testing among the 20 countries increased from 166,108 to 356,573 from the first to sixth quarter (Figure). During this period, the number of positive results more than tripled from 8,186 to 27,893. The quarterly rates of HIV positivity increased from 4.9% to 7.8% overall, from 7.6% to 12.5% among persons aged ≥15 years, and from 1.2% to 2.0% among persons aged <15 years (Figure).

Among the 865,126 persons aged ≥15 years tested for whom sex was reported, 55% were females and 45% were males (Table 2). HIV index testing positivity rates were lowest among males and females aged 10–14 years (1.1% and 1.3%, respectively) and highest among men and women aged 25–49 years (13.0% and 13.5%, respectively). Overall, the mean rate of index testing HIV positivity was 7.5% among females and 6.8% among males.

Discussion

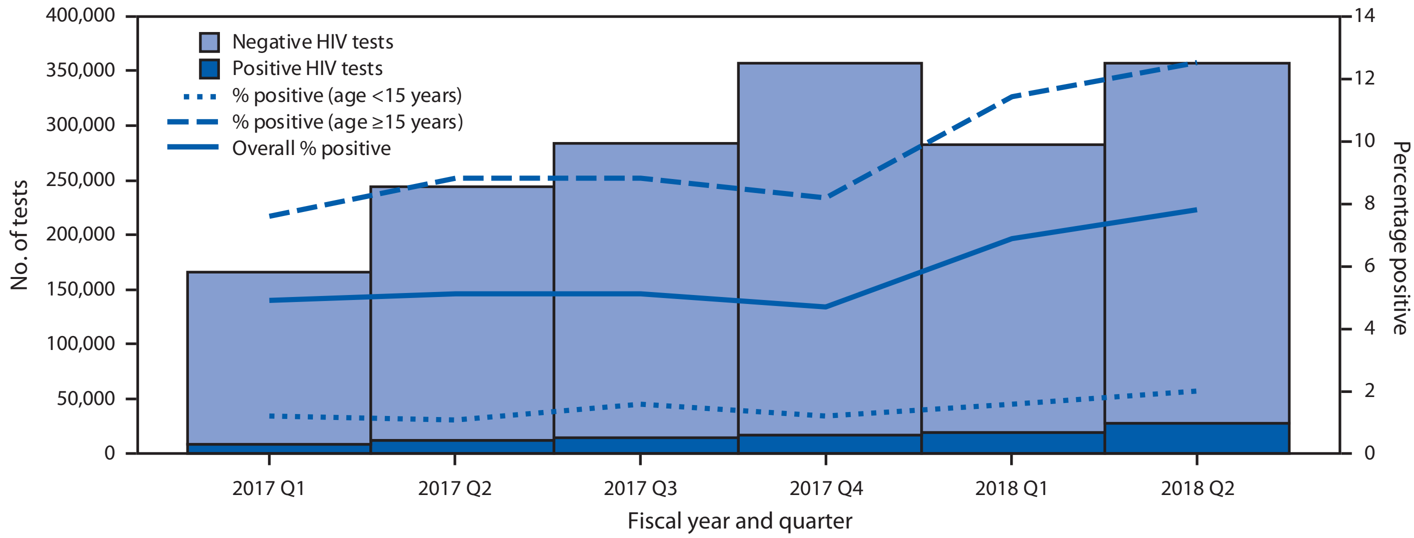
From October 1, 2016, to March 31, 2018, CDC-supported PEPFAR partners in 20 countries reported administering a total of 66 million HIV tests over all approaches, 70% of which

TABLE 1. Number of human immunodeficiency virus (HIV) index tests performed,* and number and percentage of HIV-positive results, by age group and country — 20 countries, October 1, 2016–March 31, 2018†

	Persons aged ≥15 yrs		Persons aged <15 yrs		Total§	
Country	No. of HIV tests	No. of HIV-positive results (%)	No. of HIV tests	No. of HIV-positive results (%)	No. of HIV tests	No. of HIV-positive results (%)
Mozambique	190,474	34,876 (18.3)	283,755	4,395 (1.5)	**474,801**	**39,351 (8.3)**
Kenya	174,839	7,616 (4.4)	212,676	1,435 (0.7)	**387,599**	**9,053 (2.3)**
Tanzania	101,004	6,784 (6.7)	59,206	1,012 (1.7)	**160,920**	**7,816 (4.9)**
Zambia	95,896	5,949 (6.2)	56,575	862 (1.5)	**152,474**	**6,814 (4.5)**
Namibia	52,580	5,234 (10.0)	211	4 (1.9)	**52,791**	**5,238 (9.9)**
Côte d'Ivoire	36,178	4,130 (11.4)	46,599	997 (2.1)	**82,785**	**5,127 (6.2)**
South Africa	40,294	4,985 (12.4)	1,991	138 (6.9)	**42,285**	**5,123 (12.1)**
Ethiopia	68,999	3,309 (4.8)	48,670	839 (1.7)	**117,731**	**4,154 (3.5)**
Cameroon	27,104	3,437 (12.7)	18,182	293 (1.6)	**45,371**	**3,735 (8.2)**
Zimbabwe	10,897	2,374 (21.8)	14,071	640 (4.5)	**24,968**	**3,014 (12.1)**
Eswatini¶	6,917	1,881 (27.2)	169	11 (6.5)	**7,088**	**1,892 (26.7)**
Malawi	8,561	1,426 (16.7)	2,999	144 (4.8)	**11,602**	**1,573 (13.6)**
DRC	7,949	1,078 (13.6)	6,723	364 (5.4)	**14,672**	**1,442 (9.8)**
Uganda	26,990	1,140 (4.2)	16,277	160 (1.0)	**43,267**	**1,300 (3.0)**
Lesotho	9,626	988 (10.3)	18,421	145 (0.8)	**28,056**	**1,133 (4.0)**
Haiti	7,997	616 (7.7)	761	34 (4.5)	**18,563**	**652 (3.5)**
South Sudan	1,064	310 (29.1)	895	219 (24.5)	**1,959**	**529 (27.0)**
Rwanda	13,852	381 (2.8)	11,535	114 (1.0)	**25,424**	**495 (1.9)**
Vietnam	5,725	395 (6.9)	26	1 (3.8)	**5,752**	**396 (6.9)**
Botswana	2,653	357 (13.5)	234	7 (3.0)	**2,890**	**364 (12.6)**
Total	**889,599**	**87,266 (9.8)**	**799,976**	**11,814 (1.5)**	**1,700,998**	**99,201 (5.8)**

Abbreviation: DRC = Democratic Republic of the Congo.
* Testing was supported by CDC through the U.S. President's Emergency Plan for AIDS Relief.
† Among 33 reporting countries, seven reporting <1,000 tests (Angola, China, Dominican Republic, El Salvador, Guyana, Honduras, and Thailand) and four reporting <500 tests during October 1, 2017–March 31, 2018 (India, Kazakhstan, Kyrgyzstan, and Tajikistan) were excluded. Also excluded were Nigeria and Ukraine, in response to country office requests.
§ Total might differ from sum of persons aged ≥15 years and persons aged <15 years because of incompleteness of reporting by age group.
¶ The reporting definition for index testing used by Eswatini has changed and might affect the results.

FIGURE. Percentage of quarterly human immunodeficiency virus (HIV) index tests with HIV-positive results, overall and by age group — 20 countries,* October 1, 2016–March 31, 2018



* Botswana, Cameroon, Côte d'Ivoire, Democratic Republic of the Congo, Eswatini, Ethiopia, Haiti, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, South Sudan, Tanzania, Uganda, Vietnam, Zambia, and Zimbabwe.

occurred in facility settings and 30% in community-based settings. The HIV positivity rate using all testing approaches was 1.0% among persons aged <15 years and 4.1% among persons aged ≥15 years (*10*). The rates of positivity reported through index testing were higher, 1.5% among persons aged <15 years and 9.8% among persons aged ≥15 years. The variation in HIV testing positivity among countries is likely related to differences in coverage with HIV services; in countries where coverage is low, the likelihood of eliciting HIV-positive contacts who did not know their status is higher than in countries where coverage with HIV services is high. Data indicate that both the volume and efficiency of the index testing approach are increasing, and index testing represented 2.4% of all tests reported among HIV testing delivery services (*10*). This suggests that index testing is a promising strategy for identifying HIV-positive persons, particularly in countries with low coverage with HIV services.

The percentage of index testing HIV positivity was similar among men and women; however, percentages for adults and children varied widely. Children are likely to have acquired HIV infection perinatally, and the rate of index testing positivity among persons aged <15 years is much lower than that of persons in older age groups, who likely acquired HIV from sexual and needle-sharing partners.

The findings in this report are subject to at least three limitations. First, the data might include HIV-positive persons aware of their status who chose to retest or HIV-negative persons who tested more than once during the reporting period. Removing these duplicate testing events is not possible because routine data are reported in aggregate and many of the countries do not have unique population identifiers to support the

TABLE 2. Number of human immunodeficiency virus (HIV) index tests performed* and number and percentage of HIV-positive results, by age group and sex — 20 countries,† October 1, 2016–March 31, 2018

Characteristic	No. of HIV tests	No. of HIV-positive tests (%)
Age group (yrs)		
<1	19,281	597 (3.1)
1–9	466,534	7,333 (1.6)
10–14	294,194	3,625 (1.2)
15–19	207,958	6,582 (3.2)
20–24	158,036	10,563 (6.7)
25–49	434,553	57,559 (13.2)
≥50	64,579	6,279 (9.7)
Unknown	55,863	6,663 (11.9)
Sex		
Female	628,669	47,109 (7.5)
Male	497,309	33,982 (6.8)
Unknown	485,815	7,930 (1.6)
Sex/Age group (yrs)		
Female		
10–14	156,571	2,066 (1.3)
15–19	116,806	4,281 (3.7)
20–24	97,267	7,402 (7.6)
25–49	226,788	30,598 (13.5)
≥50	31,237	2,762 (8.8)
All females aged ≥15 years	472,098	45,043 (9.5)
Male		
10–14	137,623	1,559 (1.1)
15–19	91,152	2,301 (2.5)
20–24	60,769	3,161 (5.2)
25–49	207,765	26,961 (13.0)
≥50	33,342	3,517 (10.5)
All males aged ≥15 years	393,028	35,940 (9.1)
Total	**1,700,998**	**99,201 (5.8)**

* Testing was supported by CDC through the U.S. President's Emergency Plan for AIDS Relief.

† Botswana, Cameroon, Côte d'Ivoire, Democratic Republic of the Congo, Eswatini, Ethiopia, Haiti, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, South Sudan, Tanzania, Uganda, Vietnam, Zambia, and Zimbabwe.

Summary

What is already known about this topic?

Index testing identifies the exposed partners and biologic children of persons with diagnosed human immunodeficiency virus (HIV) infection and offers these contacts HIV testing services.

What is added by this report?

From October 2016 to March 2018, both the number of persons tested for HIV and the number who received a diagnosis of HIV infection using index testing increased in 20 CDC-supported countries. With an HIV positive rate that is more than twice that of all HIV testing approaches combined, index testing was found to be a more efficient approach to HIV case finding.

What are the implications for public health practice?

Expanding index testing services could help increase the number of HIV-positive persons who know their HIV infection status, increase the number who receive antiretroviral treatment, and, as a result, reduce the number of persons who can transmit the virus.

deduplication of testing records. Second, index testing has been recently prioritized, as evidenced by the December 2016 World Health Organization guidelines on HIV self-testing and partner notification,† and countries are at varying stages in index testing implementation, which might explain the wide range in HIV positivity rates. Also, reporting of index testing as a service delivery approach was introduced by PEPFAR in October 2016, and implementing partners might need an adjustment period (e.g., to avoid misclassifying nonexposed contacts such as neighbors and other household members). Thus, the data might overreport or underreport the numbers tested and positivity rate through the index testing modality in some countries. Finally, persons aged 25–49 years were categorized in one group, and differences in the rates of positivity within that group cannot be evaluated. Because the highest rates of HIV positivity were in the 25–49 year age group, evaluation of narrower age groups might provide further insights. As of October 2018, PEPFAR-funded countries have been advised to report 5-year age increments within the 25–49 years age group.

HIV testing among contacts of known index patients is an effective approach to identifying HIV-positive persons, particularly among persons aged 25–49 years. In addition, men accounted for 45% of adults tested through index testing, which suggests that index testing is an efficient method for identifying HIV-positive men, who might be missed with other approaches. Scaling up index testing as part of the overall HIV testing services strategy could help increase the number of HIV-positive persons who know their status, are initiated onto antiretroviral treatment, and consequently reduce the number of persons who can transmit the virus.

† https://www.who.int/hiv/pub/vct/hiv-self-testing-guidelines/en/.

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Using Social Media To Increase HIV Testing Among Men Who Have Sex with Men — Beijing, China, 2013–2017

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The prevalence of human immunodeficiency virus (HIV) infection in China is low overall (0.06%) (*1*); however, it is substantially higher (8.0%) among men who have sex with men (MSM) (*2*), and the stigmatization of same-sex behaviors in China presents challenges for HIV prevention and treatment efforts. In 2015, Blued, a Beijing-based media company that operates an online dating application popular among Chinese MSM, launched an ongoing HIV testing campaign that combined its push-notification[†] platform and geolocation capabilities to encourage HIV testing among MSM in Beijing. To assess trends in use of HIV testing services, Blued and CDC's China HIV program examined testing at six Blued-operated Beijing HIV testing centers from 2 years before the campaign launch in 2015 through December 31, 2017. A sharp increase in HIV testing followed the launch of Blued's online campaign, indicating that leveraging social media platforms and their geolocation-based text messaging functionality might be useful in increasing HIV testing among MSM, particularly those aged ≤35 years.

Cross-sectional studies in China suggest that MSM have a higher prevalence of HIV infection (*3*). Data indicated that the prevalence of HIV infection among MSM in China increased from 1.0% in 2003 (*1*) to 8.0% in 2015 (*2*). MSM population size estimates in China range from 5 million to 10 million; 50%–75% of HIV-positive MSM are unaware of their HIV status (*1*,*4*).

Effective high-yield testing is an entry point for HIV care and treatment (*5*); because China has >660 million smart phone users (*6*), mobile applications might be effective in targeting MSM. Blued, a Beijing-based media company that operates the largest gay male–oriented social media and geosocial networking mobile application in China, was launched in 2012, and as of 2016, had approximately 27 million registered users and 12 million monthly users in China. Since 2013, Blued has operated six drop-in testing sites in Beijing designed to provide HIV testing in a gay-friendly environment; these six sites served approximately 700 MSM per month in 2017.

In 2015, Blued launched an online campaign to promote HIV testing at its drop-in sites. Using the application's GPS-tracking capabilities, the campaign began with a one-time mass message push through the application's private message functionality in March 2015, encouraging users to get tested for HIV while they were within Beijing municipality. The campaign's outreach efforts were carried out within the framework of Blued's service agreement with its users, and HIV testing at Blued's drop-in sites conformed to local and national regulations. After the first message push, the campaign continued with monthly electronic banner promotions of HIV testing on the application's launch screen. In July 2016, an online HIV testing appointment platform was embedded in the application, which made the online HIV testing promotion routinely available through Blued. Users who accessed the links in the advertisements were redirected to a cellular phone number–based online appointment system, through which they could schedule testing at a nearby testing site. After scheduling the appointment, the selected site and date were sent to the user's cellular phone to confirm the appointment via text message. At the testing site, after providing written informed consent, participants were asked to provide basic demographic information (Blued nickname, birth date, telephone number, and college student status) and any HIV testing history and results. To adhere to the national mandate for anonymous HIV testing, names and national identity numbers were not collected. Only screening tests were recorded at the drop-in testing sites, but all persons with positive rapid test results were contacted and referred to receive confirmatory testing through local health authorities.

To assess the impact of the social media–based HIV testing promotion campaign, CDC's China HIV program (supported by the U.S. President's Emergency Plan for AIDS Relief [PEPFAR]) helped Blued conduct a secondary analysis of the data collected during 2013–2017 from the six Blued drop-in sites. Programmatic testing data were deduplicated to achieve a person-based analytic data set using a unique identification number created with participants' reported date of birth and telephone number. Blued owned the raw data and created the deidentified analytic dataset to allow secondary analyses. CDC China led the analysis and the report development. Trends in the number of HIV tests, the characteristics of persons tested, and factors associated with receiving a positive HIV rapid test result were analyzed using bivariate and multivariate logistic regression analyses. Analyses were performed using SAS software (version 9.3; SAS Institute) and p-values <0.05 were considered statistically significant. The protocol was reviewed

* These authors contributed equally to the report.

† The ability to send a message that appears on the screen of a user of the application, even if the user is not currently logged in to the application.

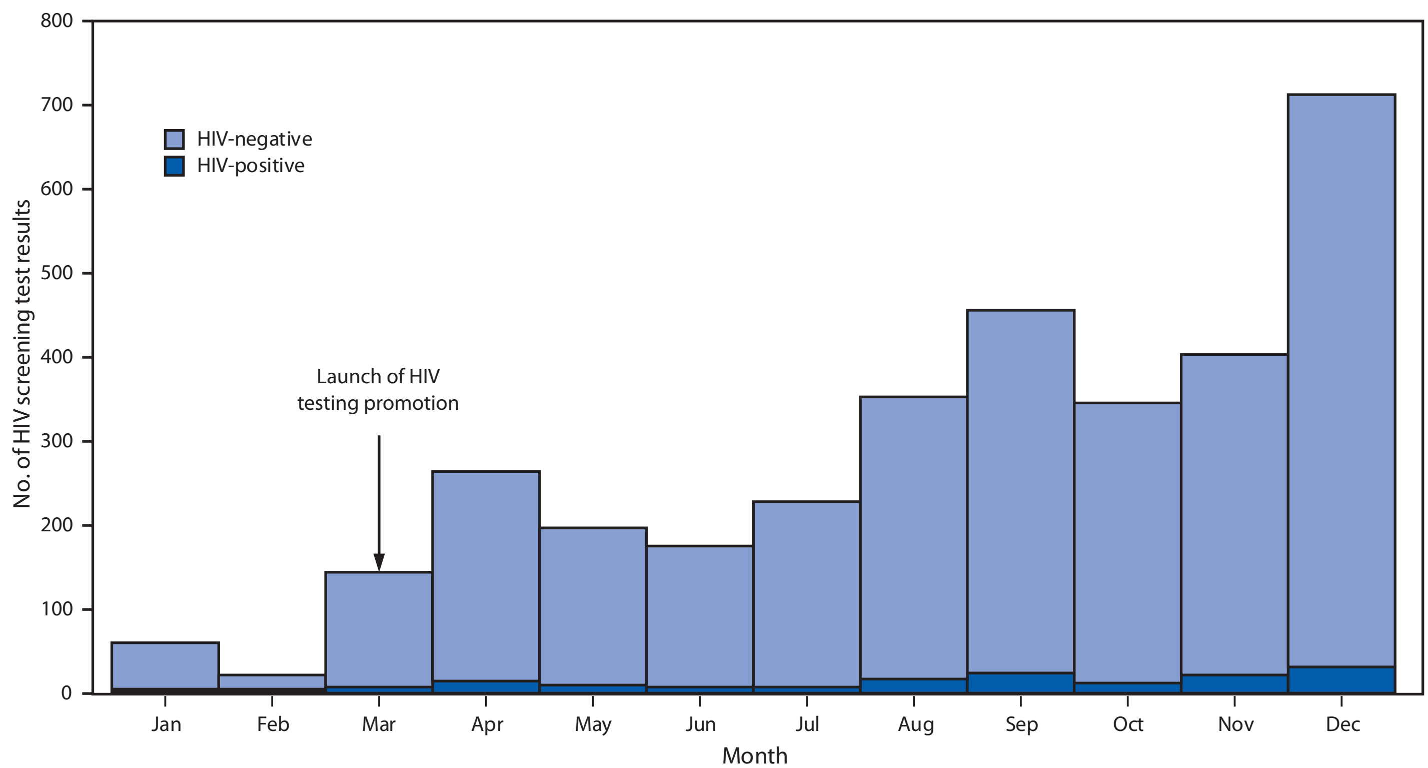
and approved by the institutional review board of the National Center for AIDS/STD Control and Prevention of CDC China (IRB00002276).

After the campaign's launch in March 2015, HIV testing volume increased sharply: 145 HIV tests were reported during March (Figure 1), a 77% increase over the 82 tests reported during January and February. The total number of tests in 2015 (3,363) represented a greater than threefold increase over the 836 tests received during 2013 and nearly a sevenfold increase over the 425 tests received during 2014 (Figure 2). The number of tests continued to increase to 6,330 in 2016 and 7,315 in 2017, representing 10 times (2016) and 12 times (2017) the average number of annual tests received during 2013–2014.

Overall, 15,932 MSM had 17,008 cumulative HIV test results recorded at one of the six Blued drop-in sites during 2015–2017. Among these MSM, 14,050 (88.2%) were aged ≤35 years (median age = 27 years [interquartile range = 24–31 years]), and 2,693 (16.9%) were college students (Table). Nearly half of participants (44.8%) had never had an HIV test. Sixty-eight percent of participants scheduled their HIV test through the link embedded in the campaign's private messages and advertisements using Blued.

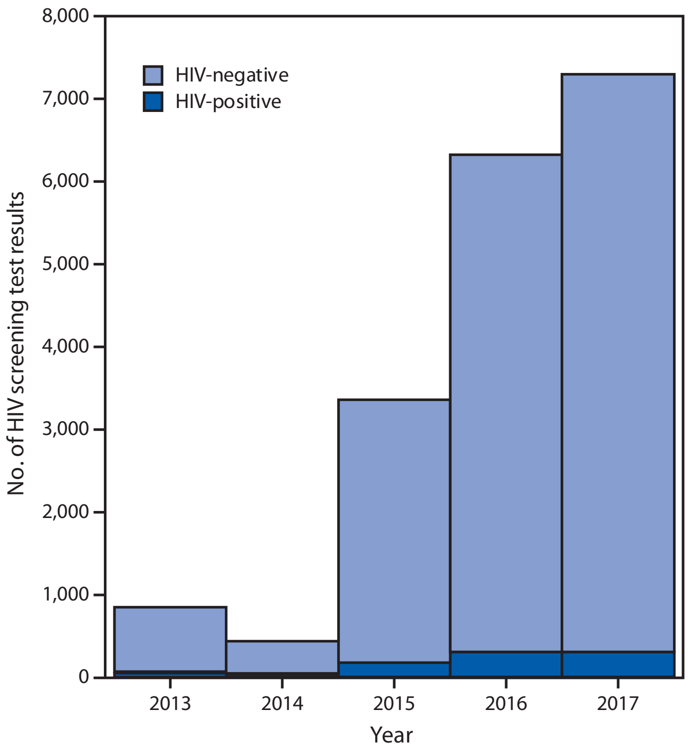
Overall, 723 (4.5%) of the 15,932 persons who obtained HIV testing at Blued sites during 2015–2017 had results positive for HIV. Compared with other referral sources, Blued contributed the largest proportion (71.2%, N = 515) of participants receiving HIV-positive results. The HIV-positivity rate was higher among participants aged >35 years (7.0%) than among those aged ≤35 years (4.2%) (p<0.001), among those who reported that they were not college students (5.0%) than among college students (2.2%) (p<0.001), and among those who were first-time testers (5.1%) than among repeat testers (4.1%) (p = 0.001). Participants referred from Blued for HIV testing had the second highest HIV-positivity rate (4.8%) compared with participants who were referred by a friend (5.6%). In multivariate analysis, age >35 years was associated with an increased odds of receiving an HIV-positive result (adjusted odds ratio [aOR] = 1.54; 95% confidence interval [CI] = 1.26–1.88; p<0.001), as were first-time testers, compared with repeat testers (aOR = 1.32; 95% CI = 1.12–1.54; p = 0.007). In contrast, college students were less likely to receive a positive HIV test result than were non-college students (aOR = 0.45; 95% CI = 0.35–0.60; p<0.001). An HIV-positive test result was not associated with the source of referral for HIV testing or the location at which a participant received HIV testing.

FIGURE 1. Number of negative and positive human immunodeficiency virus (HIV) screening test results, before and after the HIV-testing promotion campaign launch at six drop-in sites supported by Blued,* by month — Beijing, China, 2015



* A Beijing-based media company that operates an online dating application popular among Chinese men who have sex with men.

FIGURE 2. Number of negative and positive human immunodeficiency virus (HIV) screening test results at six drop-in sites supported by Blued,* by year — Beijing, China, 2013–2017



* A Beijing-based media company that operates an online dating application popular among Chinese men who have sex with men.

Summary

What is already known about this topic?

Men who have sex with men (MSM) are at higher risk for acquiring human immunodeficiency virus (HIV) infection and are a difficult subgroup to reach through traditional health care activities.

What is added by this report?

A geolocation-based online HIV testing promotion campaign from China's largest social media platform oriented to MSM coincided with a steep continuous increase in HIV testing, suggesting the campaign is effective in promoting HIV testing among MSM.

What are the implications for public health practice?

Leveraging social media platforms and their geolocation-based text messaging functionality might be useful in increasing HIV testing among MSM, particularly those aged ≤35 years.

Discussion

HIV testing volume among MSM in Beijing increased significantly at six drop-in testing sites after an online promotion campaign was deployed by Blued, the social media platform popularly used by MSM in China. These results are consistent with a previous study indicating that combining geosocial networking platforms and advertisements for HIV testing services can be an effective strategy to increase the number of MSM who obtain HIV testing (*7*). The Blued campaign was particularly effective in attracting young MSM, the population in China most affected by HIV infection (*8*).

In this analysis, first-time testers had a higher likelihood of receiving a positive HIV test result. The lower likelihood of a positive HIV test result among repeat testers might reflect a lower rate of engaging in HIV risk behaviors, the longer risk exposure among the first-time testers (lifetime) compared with that of repeat testers (time to the last negative test), or both. In 2017, an article in the China Daily reported that young college students were facing rapidly increasing risks for HIV infection (*9*). In this analysis, the rate of HIV positivity was lower among college students than among non-college students; although the majority of HIV positive test results were among MSM aged ≤35 years, only 10% of those were college students. Although the likelihood of receiving a positive HIV test result was significantly higher among participants aged >35 years, MSM in this age group accounted for <12% of the entire study population, limiting the generalizability of this finding. Other Internet-based HIV intervention projects have also had success in attracting young MSM who regularly use cellular phones for interactions with others (*10*).

The findings in this report are subject to at least three limitations. First, the data were collected as part of a programmatic activity; thus, the participants cannot be considered representative of the MSM population in Beijing. Second, college-student status was self-reported, so misclassification was possible. Finally, the project was not specifically designed to evaluate the risks for HIV infection; therefore, information that might influence HIV infection risk, including preexposure prophylaxis accessibility, condom use, and alcohol and illicit drug use, were not routinely collected.

Prioritizing the strengthening of technical assistance through partnerships with organizations actively engaging with the target population might expand the scope and reach of geosocial networking applications and facilitate understanding of users' health behaviors, HIV testing history, and other factors that affect HIV acquisition. Further studies are needed to understand the long-term benefits of push messaging and whether it retains a detectable impact after repeated use. Optimizing the efficiency of geosocial networking applications to achieve broader testing coverage among MSM could help expand the reach of these applications in this population.

TABLE. Number and percentage of men who have sex with men (N = 15,932) who tested positive for human immunodeficiency virus (HIV) at drop-in sites supported by Blued,* by selected characteristics — Beijing, China, 2013–2017

				HIV-positive			
				Bivariate analysis		Multivariable analysis	
Characteristic (no. tested	HIV-positive no. (%)	HIV-negative no. (%)	Chi-square test p-value	OR (95% CI)	p-value	aOR (95% CI)	p-value
Age (yrs); median age = 27 years, IQR = 24–31							
≤35 (14,050)	592 (4.2)	13,458 (95.8)	<0.001	1.0 (—)	<0.001	1.0 (—)	<0.001†
>35 (1,882)	131 (7.0)	1,751 (93.0)		1.70 (1.40–2.07)		1.54 (1.26–1.88)	
College student							
No (13,239)	664 (5.0)	12,575 (95.0)	<0.001	1.0 (—)	<0.001	1.0 (—)	<0.001†
Yes (2,693)	59 (2.2)	2,634 (97.8)		0.42 (0.32–0.56)		0.45 (0.35–0.60)	
Source of referral to HIV testing§							
Self-referral to drop-in sites (309)	11 (3.6)	298 (96.4)	0.004	1.0 (—)	—	1.0 (—)	—
Referral by friend (1,146)	64 (5.6)	1,082 (94.4)		1.60 (0.83–3.08)	0.16	1.71 (0.89–3.29)	0.11
New social media (Wechat, Micro-blog) (1,146)	29 (2.5)	1,117 (97.5)		0.70 (0.35–1.42)	0.33	0.82 (0.40–1.66)	0.58
Outreach/Traditional media (website) (385)	12 (3.1)	373 (96.9)		0.87 (0.38–2.00)	0.75	1.16 (0.34–4.00)	0.81
Blued (10,836)	515 (4.8)	10,321 (95.2)		1.35 (0.74–2.48)	0.33	1.56 (0.84–2.87)	0.16
Others (unknown source) (2,110)	92 (4.4)	2,018 (95.6)		1.23 (0.65–2.33)	0.52	1.42 (0.75–2.71)	0.29
First time receiving HIV testing							
No (8,793)	357 (4.1)	8,436 (95.9)	0.001	1. 0 (—)	0.001	1.0 (—)	0.007†
Yes (7,139)	366 (5.1)	6,773 (94.9)		1.28 (1.10–1.48)		1.32 (1.12–1.54)	
Testing year							
2015 (2,938)	137 (4.7)	2,801 (95.3)	0.86¶	1.0 (—)	—	1.0 (—)	—
2016 (6,075)	302 (5.0)	5,773 (95.0)		1.07 (0.87–1.31)	0.52	0.91 (0.73–1.14)	0.42
2017 (6,919)	284 (4.1)	6,635 (95.9)		0.87 (0.71–1.08)	0.21	0.77 (0.61–0.97)	0.03†
Testing sites, location/operational dates							
Site A (355), Downtown East/Feb 2013–Aug 2016	11 (3.1)	344 (96.9)	0.01	1.0 (—)	—	1.0 (—)	—
Site B (3,496), North West/Apr 2014–ongoing	154 (4.4)	3,342 (95.6)		1.44 (0.77–2.68)	0.25	1.25 (0.40–3.91)	0.70
Site C (547), North East/May 2017–ongoing	15 (2.7)	532 (97.3)		0.88 (0.40–1.94)	0.75	0.86 (0.25–2.98)	0.81
Site D (245), South West/May 2017–ongoing	13 (5.3)	232 (94.7)		1.75 (0.77–3.98)	0.18	1.59 (0.45–5.65)	0.47
Site E (4,313), Downtown West/Aug 2015–ongoing	173 (4.0)	4,140 (96.0)		1.31 (0.70–2.42)	0.40	1.22 (0.39–3.80)	0.74
Site F (6,975), South East/July 2012–ongoing	357 (5.1)	6,618 (94.9)		1.69 (0.92–3.10)	0.09	1.47 (0.47–4.55)	0.51

Abbreviations: aOR, adjusted odds ratio; CI = confidence interval; IQR = interquartile range; OR = odds ratio.
* A Beijing-based media company that operates an online dating application popular among Chinese men who have sex with men.
† Statistically significant.
§ Percentages for the source of HIV testing information for all study participants are Blued (68%), friend referral (7.2%), WeChat/Microblog (7.2%), outreach/Danlan website (2.4%), self-admission (1.9%), and other (13.2%). WeChat is equivalent to WhatsApp in China and is operated by Tencent (https://www.tencent.com/en-us/system.html); Microblog is equivalent to Twitter in China and is operated by SINA Corp (http://english.sina.com).
¶ Cochran-Armitage trend test.

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Notes from the Field

Acute Intoxications from Consumption of *Amanita muscaria* Mushrooms — Minnesota, 2018

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In October, 2018, a middle-aged ethnic Karen* man from Burma was evaluated at a hospital emergency department with altered mental status, vomiting, diarrhea, incontinence, sweating, swelling of the lip and tongue, and excessive salivation. Signs and symptoms began approximately 2–3 hours after eating mushrooms at home. The patient was admitted for supportive treatment, including endotracheal intubation for airway protection and mechanical ventilation because of acute respiratory failure and hypoxia for 4 days. His daughter, who also ate the mushrooms, was evaluated for similar, but milder symptoms, including mild sweating and nausea; she was admitted overnight for observation, and was discharged the following day. The father recovered and was discharged 8 days after admission.

An emergency department physician suspected possible cholinergic mushroom toxicosis and notified the Minnesota Poison Control System (MPCS). MPCS notified the Minnesota Department of Health (MDH), and, together with the Minnesota Mycological Society (MMS), they initiated an investigation. The patient's medical records and exposure history were obtained and reviewed, and he was interviewed through a Karen language interpreter. He described the mushroom and collection location and later sent a photo of a mushroom that he said looked similar to the one he picked. He reported that he had picked mushrooms from an area near his workplace and cooked them in turmeric, oil, and water; only he and his daughter had eaten the mushrooms, and she reportedly consumed substantially fewer mushrooms than he did. He said this was the first time he had picked mushrooms since arriving in Minnesota in 2015 and that he had selected the mushrooms because they resembled the Ochre mushroom (*Amanita hemibapha* var. *ochracea)* from his native Burma. A site visit to the location where the mushrooms were picked identified one remaining mushroom that matched the patient's description (Figure); an MMS mycologist examined the mushroom and identified it as *Amanita muscaria* var. *guessowii*.

A. muscaria mushrooms can contain ibotenic acid and muscimol, which are structurally similar to glutamate and gamma-Aminobutyric acid, respectively; ibotenic acid is capable of producing central nervous system excitation (e.g., hallucinations, agitation, or seizures), and muscimol causes central nervous system depression (*1*). Ingestion of *A. muscaria* can also cause gastrointestinal symptoms (*2*). An Internet search revealed multiple recipes by avid foragers for *A. muscaria* reported as safe for consumption; however, *A. muscaria* toxins might not be deactivated by cooking (*3*).

In 2006, an outbreak occurred among two Hmong† families in Minnesota who consumed *Amanita bisporigera*; this mushroom produces amatoxin, which is associated with gastrointestinal distress, liver failure, and high mortality. The outbreak affected nine persons and resulted in one death. Outreach efforts were focused on Hmong residents, including new arrivals in Minnesota (*4*).

FIGURE. An *Amanita muscaria* var. *guessowii* mushroom collected from the location where the patient reported collecting the mushrooms that resulted in intoxication following consumption — Minnesota, October 2018

Photo / Minnesota Mycological Society

* Karen are one of nine ethics groups in Burma. Approximately 17,000 Karen live in Minnesota, the largest Karen community in the United States.

† An ethnic group with roots in Southeast Asia. Hmong migrants began arriving in Minnesota in 1975 as refugees from the Vietnam War; approximately 66,000 Hmong live in Minnesota.

Although the *A. muscaria* mushroom consumed by the patient in this report did not contain amatoxin, the event underscored that mushroom intoxications continue to be a concern for newly arrived persons accustomed to foraging in their home countries, who might not be familiar with local mushroom ecology. Because some local toxic mushrooms might resemble edible mushrooms found in Southeast Asia, MDH reached out to the Karen Organization of Minnesota and sought to identify additional mushroom intoxication cases, increase awareness among community leaders, and initiate community messaging about potential dangers of wild mushroom foraging. No additional mushroom intoxication cases were identified. Newly arrived persons might benefit from education concerning dangers associated with and the importance of avoiding consumption of wild mushrooms.

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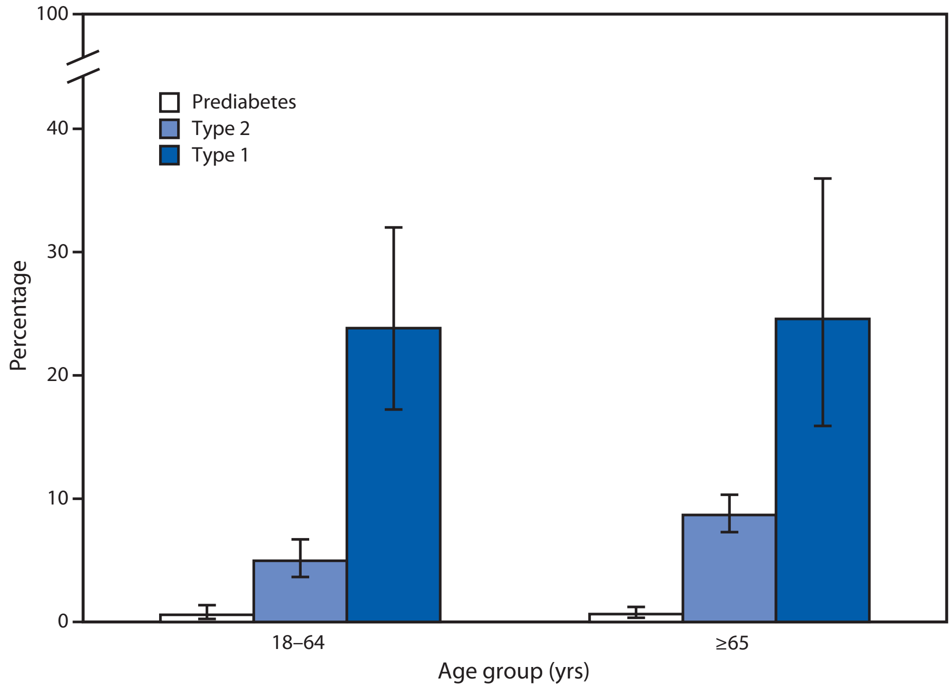
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥18 Years Reporting Diabetic Retinopathy† Among Those with Prediabetes or Diagnosed Diabetes,§ by Age Group — National Health Interview Survey,¶ 2016–2017



* With 95% confidence intervals indicated by error bars.

† Based on a response to the question "Have you ever been told by a doctor or other health professional that you had diabetic retinopathy?"

§ Diagnosed diabetes was defined by a positive response to the question, "Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" Diabetes type was defined by the response to the follow-up question, "What type (type 1 or type 2) of diabetes do you have?" In addition, a positive response to the question, "Insulin can be taken by shot or pump. Are you now taking insulin?" was required to be classified as having type 1 diabetes. Respondents who self-reported type 2 diabetes were classified as having type 2 diabetes regardless of how they answered the question about insulin use. Diabetes only during pregnancy was excluded. Prediabetes was defined by a positive response to the follow-up question, "Have you ever been told by a doctor or other health professional that you have any of the following: prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes, or high blood sugar?"

¶ Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population aged ≥18 years and are derived from the National Health Interview Survey Sample Adult component. The estimates were age-adjusted using the projected 2000 U.S. population as the standard population and using four age groups for adults aged 18–64 years (18–24, 25–34, 35–44, and 45–64 years) and two age groups for adults aged ≥65 years (65–74 and ≥75 years).

During 2016–2017, adults aged 18–64 years with type 1 diabetes were more likely to have ever had diabetic retinopathy than adults with type 2 diabetes (23.8% compared with 5.0%). Adults aged ≥65 years with type 1 diabetes were also more likely to have ever had diabetic retinopathy than adults with type 2 diabetes (24.6% compared with 8.7%). For both age groups, among those with prediabetes, the prevalence of diabetic retinopathy was 0.6%.

Source: National Health Interview Survey, 2016–2017. https://www.cdc.gov/nchs/nhis.htm.

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