CITY OF LOWELL, MASSACHUSETTS

BOARD OF HEALTH

<u>AGENDA:</u> Board of Health February 5, 2020 at 6:00 P.M. in the <u>Mayor's Reception Room, 375 Merrimack St., 2nd floor, Lowell, MA 01852.</u>

JANUARY 29, 2020

Michael Geary, City Clerk 375 Merrimack Street Lowell, Massachusetts 01852

Dear Mr. Geary: In accordance with Chapter 303 of the Acts of 1975 you are hereby notified that a meeting of the Lowell Board of Health will be held on Wednesday, FEBRUARY 5, 2020 @ 6:00 P.M. in the Mayor's Reception Room, 375 Merrimack St., 2nd floor, Lowell, MA 01852.

<u>AGENDA:</u>

1. New Business

1.I. For Acceptance: Minutes Of The January 8, 2020 Meeting Of The Board Of Health.
Motion: To accept the minutes of the January 8, 2020 meeting of the Board of Health.

Documents:

BOH MINUTES - DRAFT JANUARY 8, 2020.PDF

1.II. For Review: Tobacco Control Monthly Report Submitted By Cesar Pungirum, Program Director.

Documents:

TOBACCO REPORT_JAN2020.PDF

1.III. Monthly Development Services Report Submitted By Senior Sanitary Code Inspector Shawn Machado.

Documents:

DEVELOPMENT SERVICES - FOOD INSPECTION REPORT 2.5.2020.PDF
DEVELOPMENT SERVICES - FAILED INSPECTION REPORT 2-5-2020.PDF
DEVELOPMENT SERVICES - NEW FOOD ESTABLISHMENTS 2.5.2020.PDF
DEVELOPMENT SERVICES - BODY ART JANUARY 2020 INSPECTIONS.PDF

1.IV. For Review: Trinity EMS, Inc. Reports
Review of Monthly and Quarterly Reports submitted by Jon Kelley.

Documents:

TRINITY EMS INC OVERDOSE REPORT DECEMBER 2019.PDF
TRINITY Q4 2019 REPORT.PDF

2. Old Business

2.I. For Review: Massachusetts DPH BEH Indoor Air Quality Reports For Lowell High School
Air Quality Control Re-inspection Reports for Lowell High School

Documents:

LOWELL HS FRESHMAN ACADEMY REASSESSMENT INDOOR AIR QUALITY REPORT JAN 2020.PDF
LOWELL-HS-1920S BUILDING-REASSESS-DEC-2019 - HANDOUT.PDF
LOWELL-HS-1980S BUILDING-REASSESS-DEC-2019 - HANDOUT.PDF
HANDOUT - COMMUNICATION - BOH UPDATE INDOOR AIR QUALITY ASSESSMENT - C.CLANCY 2.5.2020.PDF

2.II. Update: CDC Investigation Of Increase Of HIV Cases In Massachusetts Drug Users

Documents:

MMWR NOTES FROM THE FIELD HIV DIAGNOSES AMONG PERSONS WHO INJECT DRUGS - NORTHEASTERN MASSACHUSETTS 3.15.19.PDF
UPDATE-ON-LOWELL-LAWRENCE-HIV-OUTBREAK.PHC_.040319.PDF
AJPH JANUARY 2020 OPIOID USE FUELING HIV TRANSMITTION IN AN URBAN SETTING - AN OUTBREAK OF HIV INFECTION AMONG PEOPLE WHO INJECT DRUGS.PDF

3. Director's Report

3.I. Update: Divisional And Departmental Updates

Documents:

COMMUNITY HEALTH DIVISION - BOARD OF HEALTH REPORT 02.05.2020.PDF
PUBLIC HEALTH DIVISION DECEMBER 2019 2.5.19.PDF
SCHOOL HEALTH DIVISION - DECEMBER REPORT BOH 2.5.20.PDF
SUBSTANCE ABUSE AND PREVENTION DIVISION - BOH REPORT 2.5.20.PDF

4. 4. Motion: To Adjourn.
Motion: To adjourn.

THE NEXT MEETING OF THE BOARD OF HEALTH WILL BE HELD ON MARCH 4, 2020 IN THE MAYOR'S RECEPTION ROOM.

CITY OF LOWELL, MASSACHUSETTS

BOARD OF HEALTH

January 8, 2020

A meeting of the Lowell Board of Health was held on Wednesday, January 8, 2020 in the Mayor's Reception Room, City Hall, 375 Merrimack St., Lowell, MA 01852. Chairwoman Jo-Ann Keegan called the meeting to order at 6:03 P.M.

Present:
John Donovan, Board Member
William Galvin, Board Member
Lisa Golden, Board Member
Kathleen Cullen-Lutter, Board Member
Jo-Ann Keegan, Interim Director of Health & Human Services
Cesar Pungirum, Tobacco Control Director
Shawn Machado, Sr. Sanitary Code Inspector

1/8/2020 – Minutes

1. NEW BUSINESS

1. I. Election: Election of an Acting Chair of the Lowell Board of Health
Board Member William Galvin made a motion to nominate Board Member John Donovan to act as the Board of Health Chairperson during Jo-Ann Keegan's leave of absence. Seconded by Lisa Golden.

VOTE:
William Galvin - yes
John Donovan - yes
Lisa Golden - yes
Kathleen Cullen-Lutter - yes
Motion passes.

1. II. For Acceptance: Minutes Of The December 11, 2019 Meeting Of The Board Of Health.
Motion to accept the minutes of the December 11, 2019 Board of Health meeting made by Lisa Golden, seconded by William Galvin. All in favor.

1. III. For Review: Tobacco Control Monthly Report Submitted By Cesar Pungirum, Program Director.
Tobacco Control Director Cesar Pungirum reviewed the report with the Board. Mr. Pungirum informed the Board that the City Council passed an ordinance prohibiting smoking in public parks. The fine for violating the ordinance is $300.

Mr. Pungirum informed the Board that, due to recent changes in the State Law, he would like to withdraw the tabled proposal to change the City's Tobacco Regulations. The Board was in agreement to do so. Mr. Pungirum will submit proposed changes to the regulation in the future if needed.

Mr. Pungirum spoke to the Board about the Two 55 Club on Westford Street regarding smoking and how the owner is attempting to exercise the smoking bar exception to the State Law. It is possible that the Board may want to think about regulations pertaining to smoking clubs. Member Galvin inquired if there are clear guidelines relative to smoking clubs. Mr. Pungirum informed the Board that there are guidelines that are easily adjusted. Possible options were discussed. Senior Sanitary Code Inspector Shawn Machado thought the Fire

Department should be consulted. Mr. Pungirum will contact the Fire Department and look at possible ways to tighten the private club regulations.

1. IV. Monthly Development Services Report Submitted By Senior Sanitary Code Inspector Shawn Machado. Senior Sanitary Code Inspector Shawn Machado reviewed the reports with the Board.

1. V. Discussion: Body Art - Jeff Riel Apprentice License
Motion: To revoke the Body Art Apprentice License issued to Jeffrey Riel as of January 8, 2020 made by William Galvin, seconded by Lisa Golden. All in favor.

1. VI. For Review: Trinity EMS Inc. Reports
The Board reviewed and placed on file.

2. OLD BUSINESS

2. I. Update: Massachusetts DPH BEH Indoor Air Quality Control Report - Lowell High School
Interim Health & Human Services Director Jo-Ann Keegan gave the Board a memo from DPW Commissioner Christine Clancy regarding the Status Summary of Lowell High School Indoor Air Quality Reassessment Reports. Commissioner Clancy will provide a more detailed response for the February 5, 2020 Board of Health meeting. Copies of the December 2019 Reassessment reports for the 1920's Building and Freshman Academy were passed out to the Board and will be scheduled for discussion at the February 5th meeting. Interim Director Keegan will participate in a walk-through of the facilities.
Mr. Rick Underwood was present to answer questions from the Board regarding on-going repairs. Mr. Underwood informed the Board that the roof repairs have been great in terms of water mitigation. Mr. Underwood will examine the Indoor Air Quality Reports to determining if the CO_2 levels have improved in rooms where the carpets were replaced. Member Galvin noted that some on the reported problems were due to behaviors by the teachers and students - such as the blocking of air vents, etc.

2. II. Update: Service Zone Plan.
Interim Director Keegan informed the Board that she has been in touch with Mr. Brickett regarding the Service Zone Plan. Mr. Brickett has resolved some of the reported issues. Mr. Brickett, George Rose from the City's Emergency Operations Office and others will meet with the State to finish the changes to the Plan.

3. DIRECTOR'S REPORT

3. I. Update: Divisional and Departmental Updates
Interim Director Keegan informed the Board of former HHS Director Kerran Vigroux's resignation effective January 2, 2020. The position has been posted until January 24, 2020. A committee will be established to interview prospective candidates.
Additionally, the Board was informed of Public Health Nurse Coordinator Colleen da Silva's retirement on January 3, 2020.
Member Galvin asked about the grid at the bottom of the Syringe Collection report relative to the Discarded Syringe pick up requests and the calls. Member Galvin felt the grid could be cleaned up a little bit. Board Member Lisa Golden inquired if Trinity EMS was conducting any syringe pickups. Interim Director Keegan will find out the answer.

4. Motion: To Adjourn.
Motion: To adjourn made at 7:00 PM by William Galvin, seconded by Lisa Golden. All in favor.

THE NEXT MEETING OF THE LOWELL BOARD OF HEALTH WILL BE HELD ON FEBRUARY 5, 2020 AT 6:00 PM IN THE MAYOR'S RECEPTION ROOM.

Lowell Tobacco Control Monthly Report
January/2020

Prepared by: Cesar Pungirum, M.M., J.D.
Program Director

Lowell

Inspections

I've conducted 25 inspections so far this month, with greater focus on the implementation of the new state law. While there have been no violations, inspections have been more time-consuming as retailers have been asking a lot of questions about the law.

Pricing Surveys

Fourteen pricing surveys have been conducted this month, so far.

Compliance Checks

No compliance checks conducted this month as recently trained youth is no longer available to work. I'm currently in the process of recruiting more youth.

Permit Renewal Process

All 116 active tobacco retailers have renewed their tobacco permits, most of which before the end of December.

Implementation of the new state law: An Act Modernizing Tobacco Control

The sale of flavored vaping products, including menthol, is now restricted to "smoking bars", a category of establishments "...that primarily is engaged in the retail sale of tobacco products for consumption by customers on the premises..." Currently, there are no smoking bars in Lowell and it is unlikely there will be any soon as smoking in these types of establishments is prohibited in the city. The sale of non-flavored vaping products containing 35 mg or more of nicotine is restricted to adult-only retail tobacco stores. There have been no compliance issues, so far.

We continue to receive updates and implementation guidance from the Massachusetts Tobacco Cessation and Prevention Program (MTCP). On June 1, 2020, the sale of other flavored tobacco products, including menthol cigarettes, will also be restricted to smoking bars.

CDC: Morbidity and Mortality Weekly Report (MMWR) – Early Release

Update on the nationwide e-cigarette or vaping, product use-associated lung injury (EVALI). *Report is attached.*

Centers for Disease Control and Prevention

Morbidity and Mortality Weekly Report (*MMWR*)

Weekly / January 24, 2020 / 69(3);90–94

On January 17, 2020, this report was posted online as an MMWR *Early Release.*

Vikram P. Krishnasamy, MD[1]; Benjamin D. Hallowell, PhD[2,3]; Jean Y. Ko, PhD[4]; Amy Board, DrPH[1,2]; Kathleen P. Hartnett, PhD[5]; Phillip P. Salvatore, PhD[1,2]; Melissa Danielson, MSPH[6]; Aaron Kite-Powell, MS[5]; Evelyn Twentyman, MD[4]; Lindsay Kim, MD[3]; Alissa Cyrus, MPH[7]; Megan Wallace, DrPH[2,3]; Paul Melstrom, PharmD, PhD[4]; Brittani Haag, MS[5]; Brian A. King, PhD[4]; Peter Briss, MD[4]; Christopher M. Jones, PharmD, DrPH[1]; Lori A. Pollack, MD[4]; Sascha Ellington, PhD[4]; Lung Injury Response Epidemiology/Surveillance Task Force (View author affiliations)

Summary

What is currently known about this topic?

Nationwide, 82% of patients hospitalized with e-cigarette or vaping, product use–associated lung injury (EVALI) reported tetrahydrocannabinol (THC)-containing product use. Vitamin E acetate, an additive to THC-containing e-cigarette, or vaping, products, is strongly linked to the EVALI outbreak.

What is added by this report?

The number of EVALI cases reported to CDC peaked during the week of September 15, 2019; the weekly number of hospitalized patients has since steadily declined.

What are the implications for public health practice?

Clinicians and public health practitioners should remain vigilant for EVALI cases. CDC recommends that persons not use THC-containing e-cigarette, or vaping, products, particularly from informal sources. Evidence is not sufficient to rule out the contribution of other chemicals of concern, including chemicals in either THC- or non-THC–containing products, in some reported EVALI cases.

Since August 2019, CDC, the Food and Drug Administration (FDA), state and local health departments, and public health and clinical stakeholders have been investigating a nationwide outbreak of e-cigarette, or vaping, product use–associated lung injury (EVALI) (*1*). This report updates patient demographic characteristics, self-reported substance use, and hospitalization dates for EVALI patients reported to CDC by states, as well as the distribution of emergency department (ED) visits related to e-cigarette, or vaping, products analyzed through the National Syndromic Surveillance Program (NSSP). As of January 14, 2020, a total of 2,668 hospitalized EVALI cases had been reported to CDC. Median patient age was 24 years, and 66% were male. Overall, 82% of EVALI patients reported using any tetrahydrocannabinol (THC)-containing e-cigarette, or vaping, product (including 33% with exclusive THC-containing product use), and 57% of EVALI patients reported using any nicotine-containing product (including 14% with exclusive nicotine-containing product use). Syndromic surveillance indicates that ED visits related to e-cigarette, or vaping, products continue to decline after sharply increasing in August 2019 and peaking in September 2019. Clinicians and public health practitioners should remain vigilant for new EVALI cases. CDC recommends that persons not use THC-containing e-cigarette, or vaping, products, especially those acquired from informal sources such as friends, family members, or from in-person or online dealers. Vitamin E acetate is strongly linked to the EVALI outbreak and should not be added to any e-cigarette, or vaping, products (*2*). However, evidence is not sufficient to rule out the contribution of other chemicals of concern, including chemicals in either THC- or non-THC–containing products, in some reported EVALI cases.

States and jurisdictions voluntarily report data on confirmed and probable hospitalized or deceased EVALI patients to CDC weekly using established case definitions* and data collection tools† (*1*). Self-reported substances used in e-cigarette, or vaping, products were assessed among EVALI patients, including the percentage reporting any or exclusive THC-containing product use, any or exclusive nicotine-containing product use, and use of both THC- and nicotine-containing products. To assess trends in possible EVALI-related ED visits, CDC and health departments developed a query to assess exposure to e-cigarette, or vaping, products as a reason for an ED visit§ (*3,4*).

As of January 14, 2020, all 50 states, the District of Columbia, the U.S. Virgin Islands, and Puerto Rico had reported 2,668 hospitalized EVALI patients (Table). Overall, 66% of patients were male. The median patient age was 24 years (range = 13–85 years), and 76% were aged <35 years. Most EVALI patients were non-Hispanic white (73%), and 15% were Hispanic. Among 2,022 hospitalized patients with information on substances used, 1,650 (82%) reported using any THC-containing product, and 1,162 (57%) reported using any nicotine-containing product; 669 (33%) reported exclusive THC-containing product use, and 274 (14%) reported exclusive nicotine-containing product use.

The weekly number of hospital admissions for EVALI reported to CDC peaked at 215 during the week of September 15, 2019 (Figure 1). Since then, the number of cases reported each week has continued to steadily decline. NSSP data show that the number of possible EVALI-related ED visits sharply increased during August 11–September 8, 2019, by a mean of 26 visits per million each week (95% confidence interval [CI] = 18–33) (Figure 2). The weekly visit rate peaked at 116 per million during the week of September 8, 2019, then decreased by an average of approximately four per million weekly visits (95% CI = 4–5) to 35 per million during the week of January 5, 2020. This remains higher than the rate of 23 per million ED visits during the week of August 18, 2019.

Top

Discussion

As of January 14, 2020, all 50 states, the District of Columbia, the U.S. Virgin Islands, and Puerto Rico had reported EVALI patients. The majority of EVALI patients were non-Hispanic white, young adults, and male, similar to that reported previously (*1,5,6*). Most patients reported THC-containing product use. However, 14% reported exclusive use of nicotine-containing products.

Vitamin E acetate is strongly linked to THC-containing products used by EVALI patients (*2*). However, a minority of EVALI patients consistently report exclusive use of nicotine-containing products, which might be due to several factors. First, some patients might not accurately report, or know the content of, THC or other compounds in the products they have used (*2,7*). Second, some cases might be misclassified; for example, the high sensitivity of the EVALI case definition likely lowered specificity, leading to inclusion of some patients who do not have EVALI. Third, these patients might be accurately reporting exclusive use of nicotine-containing products (*7*). A previous report found a relatively low, but longstanding, background rate of ED visits associated with e-cigarette, or vaping, products predating the current outbreak, which could in part reflect one or more chemicals of concern in nicotine-containing products; however, this background rate could also reflect sporadic cases from the same products or substances that later contributed to the wider EVALI outbreak when they became more commonly used (*4*). The contributing cause or causes of EVALI for persons reporting exclusive use of nicotine-only products warrants further investigation.

Declines in the number of EVALI cases reported each week since mid-September 2019, and ED visits associated with e-cigarette, or vaping, products reported to NSSP, indicate that the outbreak peaked in September. Reasons for the decline might be multifactorial, including rapid public health action to increase public awareness of the risk associated with THC-containing e-cigarette, or vaping, product use, as well as actions by users to reduce this risk. Identification of the strong link between EVALI and vitamin E acetate, a diluent in THC-containing products, might have resulted in removal of vitamin E acetate from these products¶,** (*2,8,9*). Further, actions by enforcement agencies might have affected the supply of informally sourced THC-containing products (*8,10*). However, clinicians, public health practitioners, and the public should remain vigilant by taking steps to reduce risk, including efforts by clinicians to identify and treat EVALI patients.

The identification of EVALI as a new clinical syndrome highlights a need for further studies. Understanding the long-term health consequences of EVALI will require long-term patient follow-up. It is not known whether additives other than vitamin E acetate in e-cigarette, or vaping, products might cause similar lung injury. In addition, ongoing surveillance for lung injury associated with e-cigarette, or vaping, product use needs to continue to detect possible increases in lung injury if new additives (e.g., a harmful diluent other than vitamin E acetate) are added to these products in the future. Syndromic surveillance helped demonstrate that EVALI was a new clinical syndrome, with ED visits sharply increasing in August 2019 and declining after peaking in September 2019 (*4*).

The findings in this report are subject to at least three limitations in addition to those already discussed related to ascertainment of the product type used. First, data related to product use were missing for 24% of patients, and many EVALI patients were not interviewed because of loss to follow-up, refusal to be interviewed, or lack of resources to conduct interviews. Any of these factors might limit the generalizability of these findings to other EVALI patients. Second, the exposure query in NSSP might have been affected by public and clinical awareness of the outbreak, which increased the likelihood that e-cigarette, or vaping, products would be mentioned in stated reasons for ED visits. Finally, NSSP coverage is not uniform across or within states, and health care facilities contributing data change over time as new facilities are added to the system or removed when they close.

Based on data obtained in the investigation of EVALI since August 2019, CDC recommends that persons not use THC-containing e-cigarette, or vaping, products, particularly those from informal sources such as friends, family members, or from in-person or online dealers.[††] Vitamin E acetate is strongly linked to the EVALI outbreak; it has been detected in product samples tested by FDA and state laboratories and in lung fluid samples from patients tested by CDC from geographically diverse states (*2,8,9*). Vitamin E acetate should not be added to any e-cigarette, or vaping, products. In addition, any substances not intended by the manufacturer should not be added to e-cigarette, or vaping, products, including to products purchased through retail establishments. However, evidence is not sufficient to rule out the contribution of other chemicals of concern, including chemicals in either THC- or non-THC–containing products, in some reported EVALI cases. Adults using e-cigarette, or vaping, products as an alternative to cigarettes should not go back to smoking; they should weigh all available information and consider using FDA-approved cessation medications.[§§] They should contact their health care provider if they need help quitting tobacco products, including e-cigarettes, and if they have concerns about EVALI. Adults who do not currently use tobacco products should not start using e-cigarette, or vaping, products. Finally, e-cigarette, or vaping, products should never be used by youths, young adults, or pregnant women.

Top

Acknowledgments

Sarah Khalidi, Sondra Reese, Alabama Department of Public Health; Eric Q. Mooring, Joseph B. McLaughlin, Alaska Division of Public Health; Emily M. Carlson, Tiana Galindo, Arizona Department of Health Services; Allison James, Appathurai Balamurugan, Brandy Sutphin, Arkansas Department of Health; California Department of Health EVALI Investigation Team, California Department of Public Health; Elyse Contreras, Richard Holdman, Colorado Department of Public Health and Environment; Sydney Jones, Jaime Krasnitski, Connecticut Department of Public Health; Caroline Judd, Amanda Bundek, Delaware Department of Health and Social Services, Division of Public Health; Adrienne Sherman, Kenan Zamore, District of Columbia Department of Health; Heather Rubino, Thomas Troelstrup, Florida Department of Health; Lung Injury Response Team, Georgia Department of Public Health; Hawaii Department of Health; Kathryn A. Turner, Eileen M. Dunne, Scott C. Hutton, Idaho Division of Public Health; Lori Saathoff-Huber, Dawn Nims, Illinois Department of Public Health; Charles R. Clark, Indiana State Department of Health; Chris Galeazzi, Nicholas Kalas, Tom Salter, Tyra Goss, Iowa Department of Public Health; Amie Cook, Justin Blanding, Kansas Department of Health and Environment; Kentucky Department for Public Health; Julie Hand, Theresa Sokol, Louisiana Department of Health; Maine Center for Disease Control and Prevention; Clifford S. Mitchell, Kenneth A Feder, Maryland Department of Health; Ryan Burke, Larry Madoff, Massachusetts Department of Public Health; Rita Seith, Eden V. Wells, Michigan Department of Health and Human Services; Stacy Holzbauer, Terra Wiens, Jo Taylor, Cory Cole, Paige D'Heilly, Jamie Margetta, Ruth Lynfield, Minnesota Department of Health; Paul Byers, Kathryn Taylor, Mississippi State Department of Health; Valerie Howard, George Turabelidze, Missouri Department of Health and Senior Services; Greg Holzman, Montana Department of Public Health and Human Services; Matthew Donahue, Tom Safranek, Nebraska Department of Health and Human Services; Melissa Peek-Bullock, Victoria LeGarde, Ashleigh Faulstich, Nevada Department of Health and Human Services; Suzann Beauregard, Darlene Morse, Pascal Kalin, New Hampshire Department of Health and Human Services; Stephen Perez, Lisa McHugh, New Jersey Department of Health; Joseph T. Hicks, Alex Gallegos, New Mexico Department of Health; EVALI Investigation team,, New York State Department of Health; Lauren J. Tanz, Ariel Christensen, Aaron Fleischauer, North Carolina Division of Public Health; Kodi Pinks, Tracy Miller, North Dakota Department of Health; Courtney Dewart, Kirtana Ramadugu, Ohio Department of Health; Tracy Wendling, Claire B. Nguyen, Oklahoma State Department of Health; Tasha Poissant, Amanda Faulkner, Steve Rekant, Laurel Boyd, Oregon Health Authority; Kumar Nalluswami, Brittany N. Spotts, Pennsylvania Department of Health; Ada Lily Ramírez Osorio, Departamento de Salud de Puerto Rico; Ailis Clyne, James Rajotte, Morgan Orr, Rhode Island Department of Health; Virginie Daguise, Sharon Biggers, Daniel Kilpatrick, South Carolina Department of Health & Environmental Control; Joshua L. Clayton, Jonathan Steinberg, Kipp Stahl, South Dakota Department of Health; Kelly Squires, Julie Shaffner, Tennessee Department of Health; Ketki Patel, Varun Shetty, Haylea Stuteville, DeLayna Goulding, Emily Hall, Texas Department of State Health Services; Esther M. Ellis, US Virgin Islands Department of Health; Keegan McCaffery, Jordan Green, Utah Department of Health; Vermont Department of Health;

Lilian Peake, Jonathan Falk, Virginia Department of Health; Trevor Christensen, Melanie Payne, Washington State Department of Health; Shannon McBee, Christy Reed, West Virginia Department of Health and Human Resources; Jonathan Meiman, Ian Pray, Wisconsin Department of Health Services; Melissa Taylor, Wyoming Department of Health; Lung Injury Response.

Lung Injury Response Epidemiology/Surveillance Task Force

Amena Abbas, National Center for Chronic Disease Prevention and Health Promotion, CDC; Adebola Adebayo, National Center for Immunization and Respiratory Diseases, CDC; Sukhshant Atti, Agency For Toxic Substances and Disease Registry, CDC; Tegan Boehmer, National Center for Environmental Health, CDC; Elizabeth Carter, National Center for Environmental Health, CDC; Gyan Chandra, National Center for Chronic Disease Prevention and Health Promotion, CDC; Lindsay Eckhaus, National Center for Chronic Disease Prevention and Health Promotion, CDC; Janet Hamilton, Council of State and Territorial Epidemiologists; Mia Israel, Council of State and Territorial Epidemiologists; Zheng Li, Agency For Toxic Substances and Disease Registry, CDC; Caitlin Loretan, National Center for Immunization and Respiratory Diseases, CDC; Ruth Lynfield, Minnesota Department of Health; Nisha Nataraj, National Center for Injury Prevention and Control, CDC; Mary Pomeroy, National Center for Emerging and Zoonotic Infectious Diseases, CDC; Caroline Schrodt, National Center for Emerging and Zoonotic Infectious Diseases, CDC; Herschel Smith, National Center for Injury Prevention and Control, CDC; Kimberly Thomas, Center for Surveillance, Epidemiology, and Laboratory Services, CDC; Angela Werner, National Center for Environmental Health, CDC.

Top

Corresponding author: Vikram P. Krishnasamy, VKrishnasamy@cdc.gov.

Top

---

[1]National Center for Injury Prevention and Control, CDC; [2]Epidemic Intelligence Service, CDC; [3]National Center for Immunization and Respiratory Diseases, CDC; [4]National Center for Chronic Disease Prevention and Health Promotion, CDC; [5]Center for Surveillance, Epidemiology, and Laboratory Services, CDC; [6]National Center on Birth Defects and Developmental Disabilities, CDC; [7]Office of Minority Health and Health Equity, CDC.

Top

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

Top

* https://www.cdc.gov/tobacco/basic_information/e-cigarettes/assets/2019-Lung-Injury-Surveillance-Case-Definition-508.pdf .

† https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/healthcare-providers/pdfs/National-Case-Report-Form-v01.pdf .

§ NSSP records free-text comments about the reason for ED visit, discharge diagnosis codes, and patient demographic characteristics from approximately 70% of ED visits nationwide.

¶ https://www.detroitnews.com/story/news/local/michigan/2019/12/17/michigan-recalls-marijuana-vaping-products-vitamin-e-acetate/2679157001/ .

** https://www.cnn.com/2019/12/24/health/black-market-vapes/index.html .

†† https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html.

§§ https://www.cdc.gov/tobacco/campaign/tips/quit-smoking/index.html?s_cid.

Top

References

1. Moritz ED, Zapata LB, Lekiachvili A, et al.; Lung Injury Response Epidemiology/Surveillance Group. Update: characteristics of patients in a national outbreak of e-cigarette, or vaping, product use–associated lung injuries—United States, October 2019. MMWR Morb Mortal Wkly Rep 2019;68:985–9. https://www.cdc.gov/mmwr/volumes/68/wr/mm6843e1.htm?s_cid=mm6843e1_w
2. Blount BC, Karwowski MP, Shields PG, et al.; Lung Injury Response Laboratory Working Group. Vitamin E acetate in bronchoalveolar-lavage fluid associated with EVALI. N Engl J Med 2019;NEJMoa1916433. CrossRef

3. CDC. National Syndromic Surveillance Program (NSSP): what is syndromic surveillance? Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/nssp/overview.html

4. Hartnett KP, Kite-Powell A, Patel MT, et al. Syndromic surveillance for e-cigarette, or vaping, product use–associated lung injury. N Engl J Med 2019. https://www.nejm.org/doi/10.1056/NEJMsr1915313

5. Ellington S, Salvatore PP, Ko J, et al.; Lung Injury Response Epidemiology/Surveillance Task Force. Update: product, substance-use, and demographic characteristics of hospitalized patients in a nationwide outbreak of e-cigarette, or vaping, product use–associated lung injury—United States, August 2019–January 2020. MMWR Morb Mortal Wkly Rep 2020;68. https://www.dx.doi.org/10.15585/mmwr.mm6902e2 CrossRef PubMed

6. Chatham-Stephens K, Roguski K, Jang Y, et al.; Lung Injury Response Epidemiology/Surveillance Task Force; Lung Injury Response Clinical Task Force. Characteristics of hospitalized and nonhospitalized patients in a nationwide outbreak of e-cigarette, or vaping, product use–associated lung injury—United States, November 2019. MMWR Morb Mortal Wkly Rep 2019;68:1076–80. CrossRef PubMed

7. Ghinai I, Navon L, Gunn JKL, et al. Characteristics of persons who report using only nicotine-containing products among interviewed patients with e-cigarette, or vaping, product use–associated lung injury —Illinois, August–December 2019. MMWR Morb Mortal Wkly Rep 2020;69. https://www.dx.doi.org/10.15585/mmwr.mm6903e1

8. Taylor J, Wiens T, Peterson J, et al. Characteristics of e-cigarette, or vaping, products used by patients with associated lung injury and products seized by law enforcement—Minnesota, 2018 and 2019. MMWR Morb Mortal Wkly Rep 2019;68:1096–1100.

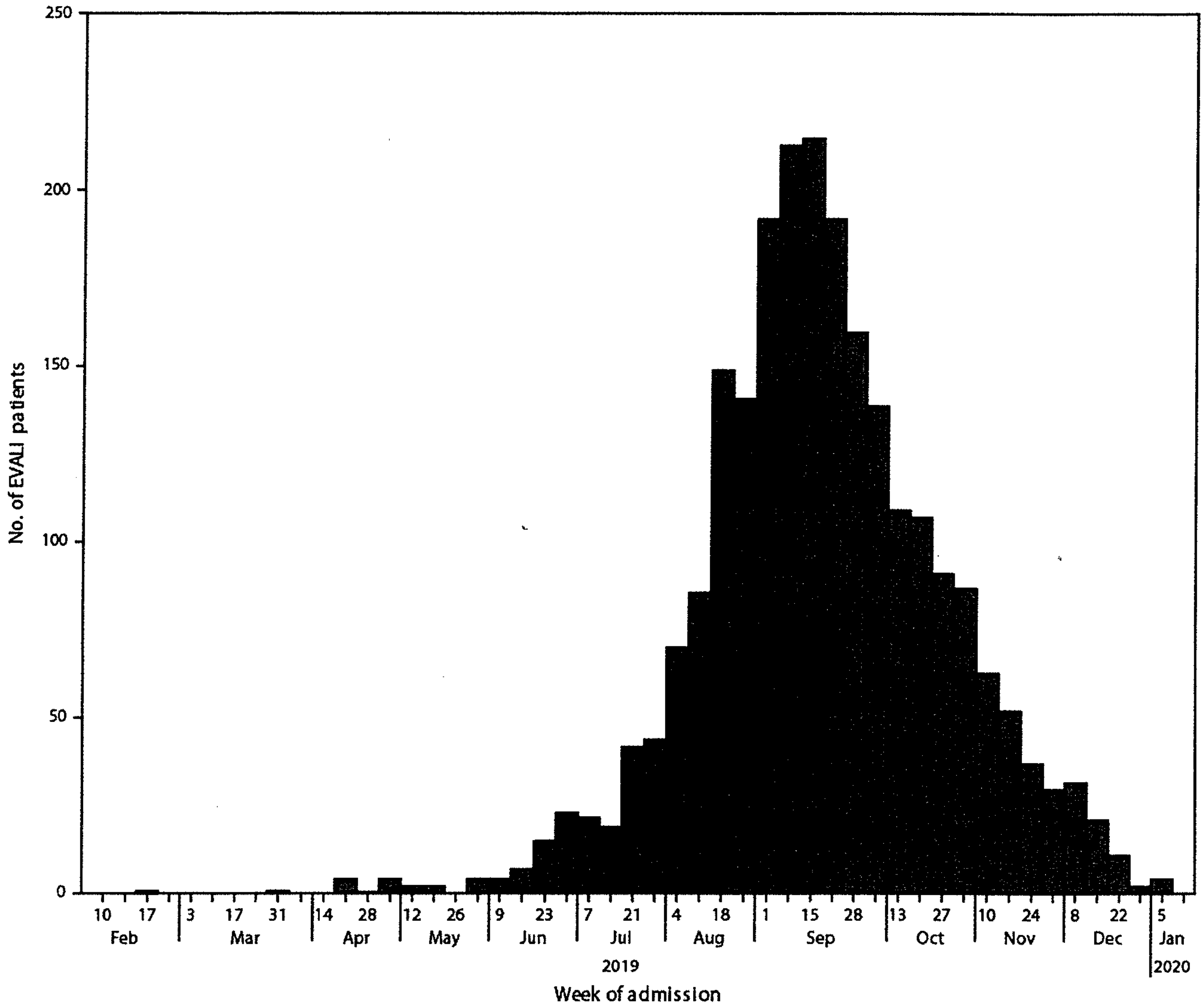
9. Food and Drug Administration. Lung illnesses associated with use of vaping products. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2019. https://www.fda.gov/news-events/public-health-focus/lung-illnesses-associated-use-vaping-products

10. Food and Drug Administration. FDA, DEA seize 44 websites advertising sale of illicit THC vaping cartridges to US consumers as part of Operation Vapor Lock. Silver Spring, MD: US Department of Health and Human services, Food and Drug Administration; 2019. https://www.fda.gov/news-events/press-announcements/fda-dea-seize-44-websites-advertising-sale-illicit-thc-vaping-cartridges-us-consumers-part-operation

Top
Top

FIGURE 1. Number of patients (N = 2,398) with e-cigarette, or vaping, product use–associated lung injury (EVALI) by week of hospital admission — United States, February 10, 2019–January 14, 2020

Return



Top

TABLE. Demographic and product use characteristics among hospitalized patients with e-cigarette, or vaping, product use–associated lung injury (EVALI) reported to CDC — United States, August 2019–January 2020* Return

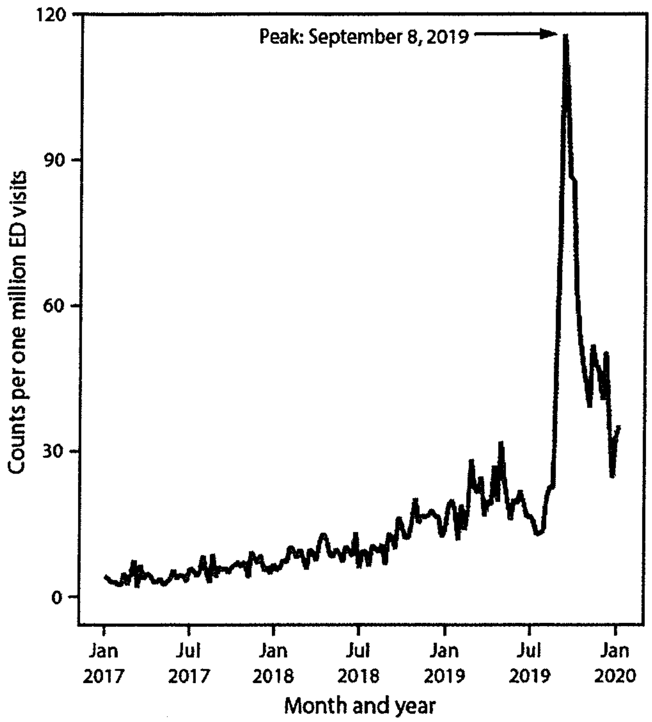
Characteristic (no. with available information)	No. (%)† (N = 2,668)
Sex (2,606)	
Male	1,731 (66)
Female	875 (34)
Median age, yrs (range)	24 (13–85)
Age group (yrs) (2,619)	
13–17	404 (15)
18–24	979 (37)
25–34	631 (24)

Characteristic (no. with available information)	No. (%)[†] (N = 2,668)
35–44	335 (13)
45–64	223 (9)
≥65	47 (2)
Race/Ethnicity[§] (1,856)	
White	1,360 (73)
Black	64 (3)
American Indian/Alaska Native	12 (1)
Asian/Native Hawaiian/Other Pacific Islander	38 (2)
Other	97 (5)
Hispanic	285 (15)
Case status (2,668)	
Confirmed	1,401 (53)
Probable	1,267 (47)
Substances used in e-cigarette, or vaping, products (2,022)[¶,]**	
Any THC-containing product	1,650 (82)
Any nicotine-containing product	1,162 (57)
Both THC- and nicotine-containing product use	834 (41)
Exclusive THC-containing product use	669 (33)
Exclusive nicotine-containing product use	274 (14)
No THC- or nicotine-containing product use reported	44 (2)

Abbreviation: THC = tetrahydrocannabinol.
* For cases reported to CDC as of January 14, 2020.
† Percentages might not sum to 100% because of rounding.
§ These were mutually exclusive groups. Whites, blacks, American Indians/Alaska Natives, Asians/Native Hawaiians/Other Pacific Islanders, and Others were non-Hispanic. Hispanic persons could be of any race.
¶ Limited to persons who reported vaping or dabbing at least one substance in the past 3 months.
** In the 3 months preceding symptom onset.

Top
Return

FIGURE 2. Emergency department (ED) visits with e-cigarette, or vaping, product use in the reason for visit (chief complaint)* — National Syndromic Surveillance Program, United States, January 1, 2017–January 11, 2020



* Excludes injuries unrelated to e-cigarette, or vaping, product use–associated lung injury (e.g., device explosions and accidental ingestion of e-liquid) but does not exclude potentially related syndromes such as acute intoxication from tetrahydrocannabinol or nicotine poisoning.

Top

Suggested citation for this article: Krishnasamy VP, Hallowell BD, Ko JY, et al. Update: Characteristics of a Nationwide Outbreak of E-cigarette, or Vaping, Product Use–Associated Lung Injury — United States, August 2019–January 2020. MMWR Morb Mortal Wkly Rep 2020;69:90–94. DOI: http://dx.doi.org/10.15585/mmwr.mm6903e2 .

Establishment	#	Street	Prior Inspection	Inspector 2	Last Inspection	Inspector-1
Powerhouse Juice	120	Merrimack St	26-Jun-19	Adam	20-Dec-20	Adam
Mill City Grows	650	Suffolk St			24-Jan-20	Shawn New
Steve's Catering	36	Chamberlain St.	24-Jul-19	Lisa	23-Jan-20	Lisa
Knickerbocker Athletic Assoc.	36	Chamberlain St.	24-Jul-19	Lisa	23-Jan-20	Lisa
Lowell Memorial Auditorium	50	E. Merrimack St	23-Jul-19	Lisa	23-Jan-20	Lisa
Brewed Awakening Coffee House	61	Market St, Unit #1	23-Jul-19	Lisa	23-Jan-20	Lisa
Market St., Inc.	95	Market St.	23-Jul-19	Lisa	23-Jan-20	Lisa
Chiu Yeung Bakery	165	High St	17-Jul-19		23-Jan-20	Lisa
Asados Dona Flot	197	High St.	17-Jul-19	Lisa	23-Jan-20	Lisa
Los Amigos Market	232	High St.	17-Jul-19	Lisa	23-Jan-20	Lisa
Hannaford's Supermarket	777	Rogers St.	23-Jul-19	Adam	23-Jan-20	Adam
Bento Sushi	777	Rodgers St.	23-Jul-19	Adam	23-Jan-20	Adam
Sts. Memorial Medical Center Kitchen & Café	1	Hospital Drive	17-Jul-19	Lisa	22-Jan-20	Lisa
St. Memorial Gift Shop	1	Hospital Drive	17-Jul-19	Lisa	22-Jan-20	Lisa
McDonald's	1	Varnum Ave.	23-Jul-19	Jimmy	22-Jan-20	Jimmy
Dunkin Donut	1	Hospital Drive	17-Jul-19	Lisa	22-Jan-20	Lisa
Dalphond's/Vic Pastry	1	Lilley Ave.	12-Jul-19	Adam	22-Jan-20	Adam
East End Club	15	W Fourth St.	22-Jul-19	Adam	22-Jan-20	Adam
Honest Lowell	21	Wood St.			22-Jan-20	Shawn New
Pizza Planet	105	Mammoth Rd.	24-Jul-19	Adam New	22-Jan-20	Adam
Father Norton Manor	137	High St.	21-Mar-19	Lisa	22-Jan-20	Lisa
Thirsty First	280	Central St.	31-Jul-19	Lisa	22-Jan-20	Adam
U.S. Bunting Club	449	Bolyston St.	24-Jul-19	Lisa	22-Jan-20	Lisa
Country Farms	56	Aiken Ave.	11-Jul-19	Jimmy	21-Jan-20	Jimmy
Gormley's Lunch	139	E. Merrimack St	30-Jul-19	Adam	21-Jan-20	Adam
Buck's Bar & Grill	165	Chelmsford St.	18-Jul-19	Aurea	21-Jan-20	Aurea
Target Starbucks	181	Plain St.	16-Jul-19	Aurea	21-Jan-20	Adam
Target Pizza Hut	181	Plain St.	16-Jul-19	Aurea	21-Jan-20	Adam
Target	181	Plain St.	16-Jul-19	Adam	21-Jan-20	Adam
Spartan's Pizzaria	863	Varnum Ave.	23-Jul-19	Jimmy	21-Jan-20	Jimmy
CPM Holding	1011	Pawtucket Blvd.	31-Jul-19	Jimmy	21-Jan-20	Jimmy
Moe's Southwest Grill	1235	Bridge St.	12-Jul-19	Adam	17-Jan-20	Adam
George's Restaurant	1224	Gorham St	16-Jul-19	Lisa	16-Jan-20	Lisa
Pizza Hazel	1258	Gorham St.	16-Jul-19	Lisa	16-Jan-20	Lisa
BAPS-NE	50	Stedman St.	18-Jul-19	Aurea	15-Jan-20	Aurea
Boys & Girls Club of Gr. Lowell	657	Middlesex St.	31-Jul-19	Aurea	15-Jan-20	Aurea
Rosenbloom Groceries	1088	Gorham St	22-Jul-19	Lisa	15-Jan-20	Lisa
Ornelas Enterprise	1088	Gorham St.	22-Jul-19	Lisa	15-Jan-20	Lisa
Courtyard by Marriott	30	Industrial Ave, E.	01-Aug-19	Aurea	14-Jan-20	Aurea
Lowell Car Wash	168	Plain St.	11-Jun-19	Aurea	14-Jan-20	Aurea
GNC	199	Plain St.	27-Aug-19	Aurea	14-Jan-20	Aurea
Acre Sport Bar	282	Fletcher St.	22-Jul-19	Aurea	14-Jan-20	Aurea
Alpine Butcher Shop	963	Chelmsford St.	01-Aug-19	Aurea	14-Jan-20	Aurea
Rosso's Italian Style Pizza	1275	Pawtucket Blvd.	23-Jul-19	Jimmy	14-Jan-20	Jimmy
Lucky Market	1300	Gorham St	16-Jul-19	Lisa	14-Jan-20	Lisa
KPT 1300 Liquors	1300	Gorham St.	16-Jul-19	Lisa	14-Jan-20	Lisa

Gulf Quick Mart	1401	Gorham St.	16-Jul-19	Lisa	14-Jan-20	Lisa
Princeton House	100	Princeton Blvd.	30-Jul-19	Aurea	13-Jan-20	Aurea
Infante Grocery	198	Broadway St.	16-Jul-19	Aurea	13-Jan-20	Aurea
Highland Variety	146	Pine St.	30-Oct-19	Aurea	09-Jan-20	Aurea
Bangkok Market, Inc	179	Chelmsford St.	18-Jul-19	Aurea	09-Jan-20	Aurea
Lowell Quick Mart	627	Chelmsford St.	16-Jul-19	Aurea	09-Jan-20	Aurea
L&M Liquors	424	Chelmsford St.	17-Jul-19	Aurea	08-Jan-20	Aurea
Vientaine Grocery & Video	426	Chelmsford St.	17-Jul-19	Aurea	08-Jan-20	Aurea
Family Dollar	1665	Middlesex St.	18-Jul-19	Aurea	08-Jan-20	Aurea
Gary Tipico	26	Andover St.	30-Jul-19	Jimmy	07-Jan-20	Jimmy
Lowell Lodge of Elks	40	Old Ferry Rd	05-Jun-19	Jimmy	07-Jan-20	Jimmy
Food Shines	277	Pawtucket St			06-Jan-20	Shawn New
Pizza Palace	1740	Middlesex St.	17-Jul-19	Aurea	06-Jan-20	Aurea
Honeydew Donut	1740	Middlesex St.	17-Jul-19	Aurea	06-Jan-20	Aurea
Lao' De Café	108	Merrimack St.	28-Jun-19	Adam	02-Jan-20	Adam
Mandrian Asian Bistro	24	Market St.	03-Jun-19	Adam	30-Dec-19	Adam
YMCA	35	YMCA Drive	13-Jun-19	Lisa	30-Dec-19	Lisa
Empire Hunan	87	Church St.	26-Jun-19	Lisa	30-Dec-19	Lisa
Two Chefs Are Better Than One	144	Chelmsford St	06-May-19	Shawn	30-Dec-19	Aurea
Abo Alezz	226	Appleton St.	19-Jun-19	Lisa	30-Dec-19	Lisa
Viet Thai Restaurant**	368	Merrimack St.	23-May-19	Jimmy	30-Dec-19	Jimmy
A&R African International Market	558	Gorham St	25-Jun-19	Lisa	23-Dec-19	Lisa
Powerhouse Foods	122	Merrimack St	16-Dec-19		20-Dec-19	Adam
Friend's Restaurant & Pub	350	Market St.	20-Jun-19	Aurea	20-Dec-19	Aurea

Failed Food Establishments

Meeting 2-5-20

JJ Boomers – 705 Pawtucket Blvd 12/17/19 *Emergency Closure*

Basement flooded – possible sewer leak – dye packs were negative – foul smell from flood / Clean immediately by a professional company.

Hood system not serviced – Hood and vents are extremely dirty / Get hood serviced immediately.

Overall cleanliness of kitchen is filthy / Clean immediately

*Cannot reopen until follow-up inspection shows compliance

Reinspection: Permanently Closed

Last three inspections: All Passed

Sazon Latino – 32 Westford St 12/11/19

Hood and Ansol system out of date and all extinguishers need to be inspected .

Refrigerators are dirty and unorganized.

Product out of date on shelves / remove immediately

Reinspection: 12/18/19 Compliance

Last three inspections:

China Star – 1733 Middlesex St 12/31/19

Ansol System went off - Fire Department called out / Emergency Closure

Service Master cleaned 12/31/19 / Food was removed / Fire system re-serviced.

Reinspection: 1/1/20 Compliance

Last three inspections:

Dunkin Donuts – 1505 Middlesex St – 12/10/19

Entire establishment is unclean / clean immediately

Front small refrigerator is leaking.

Floors dirty throughout establishment / clean immediately

Reinspection: 12/19/19 Compliance

Last three inspections:

Asados Dona Flor – 197 High St - 1/22/20

Fire extinguisher expired – not up to date

Board of Health Meeting 2-5-20

New Food Establishments

Powerhouse Foods – 122 Merrimack St 978-729-3244 12/16/19 / expanded Powerhouse Juice

Food Shines – 277 Pawtucket St (old Jimmy John's) 703-992-3155 1/6/20

Honest Lowell (Indian Vegetarian) – 21 Wood St - (Old Papa Gino's) 1/22/20

Mill City Grows – (not a restaurant – teaching cooking classes) 650 Suffolk St – 1/24/20

JANUARY 2020 BODY ART AND PIERCING INSPECTIONS FOR FEBRUARY 5, 2020 BOH MEETING			
NAME OF BUSINESS	**DATE INSPECTED**	**STATUS**	**INSPECTED BY**
Professional Body Piercing 147 Central Street, Lowell	**1/16/2020**	**PASSED**	**Don Murphy**
Lowell Ink 161 Worthen Street, Lowell	**1/14/2020**	**PASSED**	**Don Murphy**
Tierney's Body Art 12 Concord Street, Lowell	**1/14/2020**	**PASSED**	**Don Murphy**
Blaq Sheep Tattoos 564 Dutton Street 2nd Fl, Lowell	**1/13/2020**	**PASSED**	**Don Murphy**
Lupo Ink 1527 Middlesex St. #8, Lowell	**1/15/2020**	**PASSED**	**Don Murphy**

TRINITY EMERGENCY MEDICAL SERVICE

Overdose Report: 19-Dec

Lowell, MA

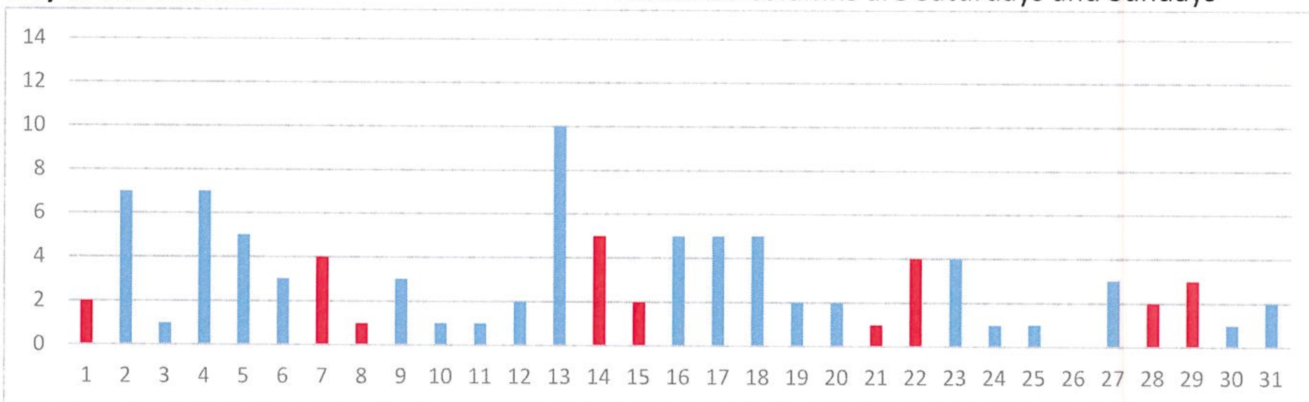
Overdoses: 95 or 3.1 per day

Day of the week:

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	
Count	20	10	14	9	18	12	12	95
Average	4.0	2.0	3.5	2.3	4.5	3.0	2.4	

Day of the month:

Note:Red columns are Saturdays and Sundays



Hour of the day:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2	1	4	2	0	4	2	2	2	1	3	6	9	4	4	5	7	2	3	4	12	4	7	5

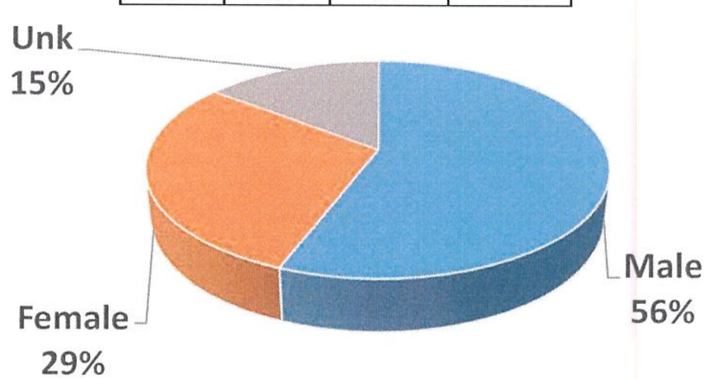
95

Section of the city:

Neighborhood	Count
Acre	12
Back Central	6
Belvidere	3
Centralville	15
Downtown	21
Highlands	11
Lower Belvidere	1
Lower Highlands	12
Pawtucketville	5
Sacred Heart	4
South Lowell	5
	95

Profile of patient

Sex	Count	Avg Age	Range
Female	28	34	11-67
Male	53	35	11-67



Age	#
12 and U	3
13-15	0
16-17	2
18-21	6
22	1
23	0
24	0
25	4
26	4
27	3
28	3
29	2
30	5
31	2
32	1
33	3
34	4
35	3
36	1
37	3
38	3
39	3
40	3
41	0
42	0
43	1
44	0
45	2
46	2
47	0
48	0
49	1
50	2
51-55	7
56-60	2
61-65	0
66-70	3
71 and up	0
Unk	16

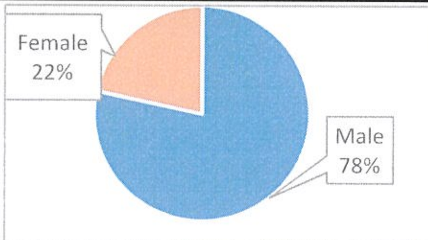
18-Dec	19-Jan	19-Feb	19-Mar	19-Apr	19-May	19-Jun	19-Jul	19-Aug	19-Sep	19-Oct	19-Nov	19-Dec
125	86	90	111	96	111	93	97	100	83	107	73	95
4.0	2.8	3.2	3.6	3.2	3.6	3.1	3.1	3.2	2.8	3.5	2.4	3.1

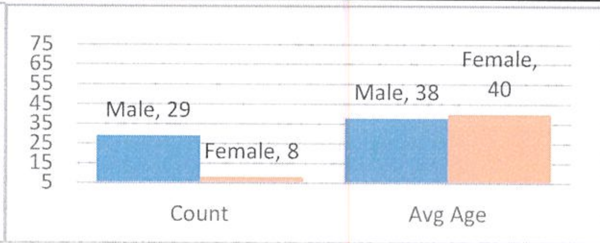
TRINITY EMERGENCY MEDICAL SERVICE

Categorized Opiate Report: Dec-19 — Lowell, MA

Priority of patient

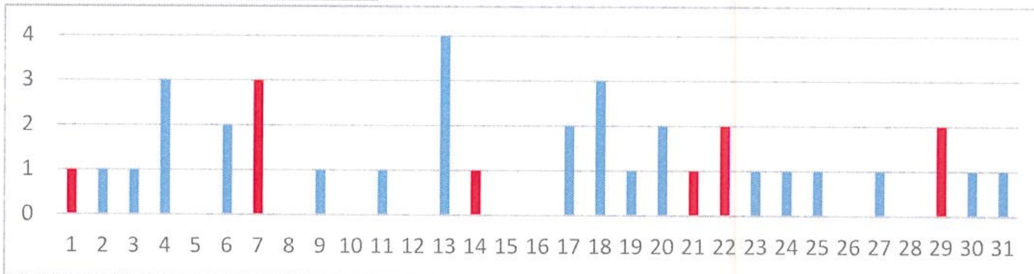
Priority 1	27
Priority 2	4
Priority 3	6





Day of the week:	#	Avg
Mon	4	0.8
Tue	5	1.0
Wed	8	2.0
Thu	1	0.3
Fri	9	2.3
Sat	5	1.3
Sun	5	1.0

Day of the month: Red are weekends (below)



Hour of the day:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	1	1	2	2	1	0	1	1	1	0	2	3	1	0	0	3	3	0	2	3	5	2	2	1

Location of patient	#
Private Residence	20
Public Location- Inside	7
Public Location- Outside	10
Residential Institutuion	0

Narcan used by:

Lowell FD	12	Lowell PD	3
Trinity ALS	1	Trinity BLS	11
LGH ALS	0	Other	6
Park Ranger	0		

Narcan doses

- 2-3mg - 6
- 4mg - 12
- 6mg - 4
- 8mg - 5

Neighborhood

Acre - 6 Back Central - 3 Centralville - 5 Downtown - 9 Highlands - 2

Lwr Highlands - 7 Pawtucketville - 1 Sacred Heart - 2 South Lowell - 2

Home town of pt

Billerica - 3, Boston - 1, Charlestown - 1, Dorchester - 1, Dracut - 1, Holden - 1, Lawrence - 1, Lowell - 17, Medford - 1, Unknown - 10

Last 12 months All ORI calls

18-Dec	19-Jan	19-Feb	19-Mar	19-Apr	19-May	19-Jun	19-Jul	19-Aug	19-Sep	19-Oct	19-Nov	19-Dec
59	42	49	43	47	46	44	46	35	46	52	36	37
1.9	1.4	1.8	1.4	1.6	1.5	1.5	1.5	1.1	1.5	1.7	1.2	1.2

Last 12 months Priority 1 only

18-Dec	19-Jan	19-Feb	19-Mar	19-Apr	19-May	19-Jun	19-Jul	19-Aug	19-Sep	19-Oct	19-Nov	19-Dec
32	23	21	23	28	25	30	26	26	27	34	23	27
1.0	0.7	0.8	0.7	0.9	0.8	1.0	0.8	0.8	0.9	1.1	0.8	0.9

ORI - daily average

	Q1	Q2	Q3	Q4	Yr avg
2013	0.7	1.2	1.1	0.6	0.9
2014	0.8	1.4	1.6	1.4	1.3
2015	1.4	1.7	1.9	1.4	1.6
2016	1.7	1.6	2.0	2.3	1.9
2017	2.0	2.3	2.8	1.8	2.2
2018	2.1	2.0	2.6	**2.2**	**2.2**
2019	1.5	1.5	1.4	1.4	1.5

Priority 1 only- daily average

	Q1	Q2	Q3	Q4	Yr avg
2013	0.3	0.4	0.5	0.2	0.3
2014	0.3	0.6	0.8	0.9	0.7
2015	0.8	0.7	0.9	0.8	0.8
2016	1.0	1.0	0.9	1.3	1.0
2017	1.2	1.4	1.6	1.0	1.3
2018	1.2	1.1	1.3	1.4	1.3
2019	0.7	0.9	0.9	0.9	0.9

Age

Age	#
12 and U	0
13-15	0
16-17	1
18-21	0
22	0
23	0
24	0
25	3
26	2
27	1
28	0
29	2
30	1
31	0
32	0
33	0
34	3
35	0
36	1
37	2
38	3
39	2
40	1
41	0
42	0
43	1
44	1
45	2
46	1
47	0
48	0
49	1
50	1
51-55	4
56-60	1
61-65	0
66-70	0
Unk	3

TRINITY
EMERGENCY MEDICAL SERVICE

The following data is from Trinity EMS electronic Patient Care Reports. This data is from calls in all 13 communities Trinity provides service for. Only data from December 2019 opioid related calls are included

Trinity EMS Inc provides EMS services for the following communities in MA: Boxford, Chelmsford, Dunstable, Groveland, Haverhill, Lowell, and Dracut. In NH: Atkinson, Danville, Hampstead, Newton, Plaistow, and Sandown.

Only opiate overdoses that Trinity EMS inc responded to are included. If someone from one of the communities listed above overdosed in another community not listed, it will not be represented in this data set.

System wide, Trinity treated 80 patients with an opioid related issue in December 2019.

Row Labels	Count of Date
LOWELL	19
HAVERHILL	17
(blank)	14
LAWRENCE	5
DRACUT	5
BILLERICA	4
AMESBURY	1
BOSTON	1
MEDFORD	1
FRANKLINVILLE	1
DORCHESTER	1
NEWTON	1
LYNN	1
NATICK	1
METHUEN	1
CHARLESTOWN	1
KINGSTON	1
OLD LYME	1
SEABROOK	1
HOLDEN	1
ALTON	1
HUDSON	1
Grand Total	**80**

TRINITY

EMERGENCY MEDICAL SERVICE

2019 4th Quarter Report to the Lowell, Massachusetts Board of Health

Reporting Period: Oct 1 – Dec 31 2019

- INTRODUCTION:

This is the 4th Qtr. 2019 Report for the Lowell Board of Health.

Any questions or concerns surrounding the contents of this report should be directed to:

Trinity EMS, Inc.

ATTN: Kirk Brigham, Director of Clinical Services

PO Box 187

Lowell, MA 01853

Email: kbrigham@trinityems.com

Thank you,

Management Team

Trinity EMS, Inc

TABLE OF CONTENTS

TIMES:	Trinity BLS Q1 2019	Trinity ALS	LGH ALS	Trinity BLS Q2 2019	Trinity ALS	LGH ALS
Fractile %	**92.75%**	**86.42%**	**91.79%**	**94.28%**	**88.21%**	**93.32%**
Avg out of chute	49 sec	55 sec	59 sec	22 sec	56 sec	48 sec
Avg resp time	5 min 16 sec	6 min 55 sec	6 min 8 sec	4 min 7 sec	5 min 47 sec	5 min 5 sec
Avg on scene time	11 min 01 sec	12 min 29 sec	13 min	10 min 58 sec	10 min 22 sec	11 min 22 sec
Avg transport time	7 min 21 sec	8 min 29 sec	13 min 52 sec	6 min 41 sec	6 min 45 sec	10 min 34 sec
# of events >7:59 response time	385	32	159	315	25	119
# of events using Non Trinity BLS	1	<--This call was the 9th emergency and was an alpha level call. This was given away in error		0		
	Trinity BLS Q3 2019	Trinity ALS	LGH ALS	Trinity BLS Q4 2019		
	93.45%	**88.50%**	**91.57%**	**91.87%**	**84.32%**	**92.12%**
Avg out of chute	24 sec	1 min	45 sec	43 sec	1 min 5 sec	50 sec
Avg resp time	4 min 11 sec	5 min 30 sec	5 min 12 sec	4 min 48 sec	4 min 53 sec	5 min 56 sec
Avg on scene time	11 min 42 sec	14 min 47 sec	13 min 10 sec	11 min 41 sec	13 min 52 sec	15 min 16 sec
Avg transport time	6 min 54 sec	7 min 38 sec	10 min 32 sec	6 min 42 sec	7 min 9 sec	10 min 44 sec
# of events >7:59 response time	375	23	156	429	37	145
# of events using Non Trinity BLS	0			1	<-- 8th 911 call in Lowell at that time	

	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q 3 2019	Q4 2019
TEMS BLS	**91.53%**	**94.04%**	**94.72%**	**94.03%**	**92.75%**	**94.28%**	**93.45%**	**91.87%**

BLS OUTLIERS:	2017 Total		2018 Total		Last 4 Qs Total		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
1st Emergency	275	25%	340	24%	386	26%	100	26%	80	25%	85	23%	121	28%
2nd Emergency	260	23%	372	26%	400	27%	99	26%	103	33%	102	27%	96	22%
3rd Emergency	195	17%	259	18%	306	20%	71	18%	49	16%	91	24%	95	22%
4th Emergency	154	14%	189	13%	181	12%	50	13%	30	10%	43	11%	58	14%
5th Emergency	108	10%	146	10%	135	9%	41	11%	24	8%	31	8%	39	9%
6th Plus Emergency	124	11%	115	8%	96	6%	24	6%	29	9%	23	6%	20	5%
			1421		1504		385		315		375		429	

BLS REASONS OVER 7:59:	2017 Yearly Tota		2018 Total		Last 4 Qs Total		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Total	1258		1421		1504		385		315		375		429	
Couldn't locate house/lost	22	2%	40	3%	88	6%	14	4%	14	4%	34	9%	26	6%
Crew took long route	60	5%	115	9%	105	7%	34	9%	27	9%	15	4%	29	7%
Distance	485	39%	350	24%	362	24%	77	20%	73	23%	85	23%	127	30%
Dispatch delay	56	4%	40	3%	141	9%	37	10%	26	8%	43	11%	35	8%
Highway	32	3%	9	1%	17	1%	4	1%	1	0%	7	2%	5	1%
Out of chute	188	15%	186	13%	149	10%	46	12%	29	9%	35	9%	39	9%
TEMS Dispatch error	45	4%	127	7%	49	3%	8	2%	12	4%	17	5%	12	3%
Weather	5	0%	47	5%	42	3%	24	6%	0	0%	11	3%	7	2%
EMD			227	16%	257	17%	63	16%	60	19%	64	17%	70	16%
911 Call volume	115	9%	235	17%	215	14%	64	17%	50	16%	45	12%	56	13%
others/blank	250	20%	45	3%	79	5%	14	4%	23	7%	19	5%	23	5%

BLS OUTLIERS:	2017 Total		2018 Total		Last 4 Qs Total		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Witin the standard (7:59 >)					20243	93.11%	4928	92.77%	5188	94.28%	5289	93.48%	4838	91.85%
0800-0859					734	3.38%	205	3.62%	158	2.79%	174	3.30%	197	3.74%
0900-0959					402	1.85%	104	1.84%	78	1.38%	110	2.09%	110	2.09%
1000-1059					201	0.92%	44	0.78%	42	0.74%	54	1.03%	61	1.16%
1100-1159					77	0.35%	15	0.27%	19	0.34%	14	0.27%	29	0.55%
1200 plus					83	0.38%	16	0.28%	18	0.32%	17	0.32%	32	0.61%
							see below		see below		see below		see below	

12 PLUS BREAKOUT	2017 Total		2018 Total		Last 4 Qs Total		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
911 Call volume (5th +)					26	31.33%	5	27.78%	8	47.06%	3	9.38%	10	31.25%
Distance						0.00%		0.00%		0.00%	1	3.13%	1	3.13%
Crew got lost/couldn't find house					11	13.25%	3	16.67%	3	17.65%	1	3.13%	4	12.50%
EMD					13	15.66%	2	11.11%	3	17.65%	3	9.38%	5	15.63%
Highway call					6	7.23%	1	5.56%	1	5.88%	1	3.13%	3	9.38%
TEMS Dispatch error/delay					13	15.66%	4	22.22%	2	11.76%	4	12.50%	3	9.38%
Others					12	14.46%	1	5.56%	1	5.88%	4	12.50%	6	18.75%

33 Q4 2019 over 12 minutes

1	Lift assist from chair to bed- no transport	16	Psy pt- waiting for PD- canceled by PD	32	ETOH- priority 2 transport
2	Pt with headache, Visiting nursing with patient	17	EMD- Fall with Visiting nurse. Prioirity 2 transport		
3	Assault pt with PD- No transport	18	Psy pt- PD was on site- Priority 3 transport		
4	Sec 12, crew arrived and waitied for PD	19	Diff breathing- Fire on site in 4, BLS transport		
5	Highway call- canceled by fire no transport	20	uninjured from a Fall. Pt refusal		
6	Nursing home- ALS on site in 6 mintues	21	EMD- Bleeding- priority 3 transport		
7	Psy pt- with PD. Priority 3 transport	22	EMD- nurse with pt. urgent CT scan- no transport		
8	Seizure call- ALS on site in 8- no transport	23	ETOH- Umass EMS with pt- priority 3 transport		
9	EMD- Pt in care of nurse- ALS transport	24	Chest pain- Fire with patient- ALS triage		
10	Pt fell- no transport	25	Hypertention- Fire with pt. Priority 1 transport		
11	Highway call-Other service BLS onsited, ALS on site in 8	26	uninjured from a Fall. Pt refusal		
		27	Diff breathing- ALS on site in 6, ALS transport		
12	Detox request- Pt with PD- priority 3 transport	28	Vomiting- priority 3 transport		
13	Pt vomiting prioirty 3 transport	29	Psy- Visiting nurse with pt- priority 3 transport		
14	Pt vomting priority 2 transports	30	Hip pain- priority 3 transport		
15	ETOH- post detox release- priority 3 transport	31	Psy- waiting for PD Prioirt 2 transport		

VOLUME:	2017		2018		Last 4 Qs		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Total responses (ALS & BLS)	29696		30318		30019		7462		7497		7710		7350	
Total ALS Responses	8196	28%	8511	28%	8276	28%	2150	29%	1994	27%	2050	27%	2082	28%
TEMS ALS Responses	871	11%	955	11%	871	11%	223	10%	212	11%	200	10%	236	11%
LGH ALS Responses	7325	89%	7556	89%	7405	89%	1927	90%	1782	89%	1850	90%	1846	89%

INCIDENTS:	21500	21807	21743	5312	5503	5660	5268
BLS Incident	13304	12340	13467	3162	3509	3610	3186
ALS and BLS Incident	8196	8467	8276	2150	1994	2050	2082
Needle pick ups		728	280	100	77	62	41
Non Emergent Lift assists		784	582	327	116	102	37

TRANSPORTS:	2017		2018		Last 4 Qs		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Total Transports (ALS & BLS)	14781		16379		16483		4082		4117		4117		4167	
Total BLS Transports	11735	79%	13078	80%	12963	79%	3135	77%	3274	80%	3206	78%	3348	80%
Total ALS Transports	3046	21%	3301	20%	3520	21%	947	23%	843	20%	911	22%	819	20%
TEMS ALS Transports	434	14%	503	15%	462	13%	123	13%	109	13%	112	12%	118	14%
LGH ALS Transports	2612	86%	2798	85%	3058	87%	824	87%	734	87%	799	88%	701	86%

TRIAGE:	2017		2018		Last 4 Qs		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Total Triaged	1102	13%	1178	14%	1072	13%	291	14%	240	12%	247	12%	294	14%
TEMS Triage	60	7%	57	6%	59	7%	13	6%	16	8%	12	6%	18	8%
LGH ALS Triage	1042	14%	1121	15%	1013	14%	278	14%	224	13%	235	13%	276	15%

INTUBATIONS:	2017	2018	Last 4 Qs Total	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Trinity company total	48 of 98 49%	63 of 69 91%	71 of 76 93%	24 of 25 96%	20 of 24 83%	12 of 12 100%	15 of 15 100%
Trinity Lowell only	2 of 7 29%	10 of 10 100%	6 of 7 86%	3 of 3 100%	1 of 2 50%	2 of 2 100%	0 of 0 ###
LGH ALS Lowell only	166 of 174 95%	151 of 155 97%	149 of 150 99%	44 of 44 100%	37 of 37 100%	26 of 27 96%	42 of 42 100%
LGH Greater Lowell region				63 of 63 100%	70 of 71 99%	56 of 57 98%	73 of 73 100%
LGH ALS MAI* in Lowell only	55	62	Last 4 Qs Total	16(24 system wide)	20 (35 system wide)	10 (22 system wide)	17 (30 system wide)
IO SUCCESS RATE:	2017	2018	Last 4 Qs Total	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Trinity company total	65 of 69 94%	81 of 81 100%	81 of 81 100%	26 of 26 100%	22 of 22 100%	16 of 16 100%	17 of 17 100%
Trinity Lowell only	6 of 6 100%	12 of 12 100%	8 of 8 100%	3 of 3 100%	2 of 2 100%	2 of 2 100%	1 of 1 100%
LGH ALS Lowell only	72 of 75 96%	83 of 83 100%	89 of 89 100%	28 of 28 100%	20 of 20 100%	18 of 18 100%	23 of 23 100%
Airways:	2017	2018	Last 4 Qs Total	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Trinity company wide- King tube success rate-post ETT failure	###		###	1 of 1 100%	3 of 3 100%	0 of 0 V/0!	0 of 0 V/0!
Trinity Lowell- King tube success rate-post ETT failure	###		###	0 of 0 na	0 of 0 na	0 of 0 na	0 of 0 na

* Intubation total- Total patients intubated/ Total Patients intubated attempted.

** Medication Assisted Intubation, in MA, this requires the use of a Paralytic which is controlled & monitored by a special project

Last Name	First Na	Title	Hire Date	Positio	MA Certification #	Nationa
Carrucini	Luis	(FT) EMT-I	2019-12-09	EMT-B	E855239	
Clemetson	Ty	(FT) EMT-I	2019-11-11	EMT-B	E0916562	E3495180
Greene	Jessica	(FT) EMT-I	2019-11-11	EMT-B	E0912177	E3368402
Honeywell	Daniel	(FT) EMT-I	2019-11-11	EMT-B	E0910912	E3346181
Sculley	Brian	(FT) EMT-I	2019-11-11	EMT-B	E0912751	E3380013
Trudel-Good	Andrew	(FT) EMT-I	2019-11-11	EMT-B	E0903359	E3148945
Lesnever	Tristan	(PT) EMT-I	2019-10-18	EMT-B	E0915431	E3461682

EMD- Direct to Trinity

	2017 Total	2018 Total	Last 4 Qs Total	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Alpha (BLS-P3)	1405	1524	1296	303	362	296	335
Bravo (BLS-P2)	410	444	453	109	125	90	129
Charlie (ALS-P1)	679	722	719	185	147	220	167
Delta (ALS-P1)	645	634	716	191	139	223	163
Echo (ALS-P1)	2	3	6	2	1	2	1
Total EMD by Trinity in Lowell	3141	3327	3190	790	774	831	795

The above data are direct calls to Trinity for patients in Lowell.

Alpha- results in BLS going no lights or sirens to the patient

Bravo- results in BLS going lights and sirens to the patient

Charlie, Delta, Echo- results in ALS and BLS going lights and sirens to the patient

As part of Trinity EMS's EMD accreditation a portion of the above calls are randomly selected for quality assurance review. TEMS reviews 25 EMD'ed calls per week. These 25 calls could come from any city or state. Potentially none or all 25 calls could be for patients in Lowell.

Trinity EMS an Accredited Center of Excellence through the International Academy of Emergency Dispatch. Trinity is 1 of 2 in Massachusetts and 1 of 184 of these centers in the world

	2017 Total		2018		2019		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Total ORI in Lowell	802		811		523		134		137		127		125	
Priority 1 ORI in Lowell	468		455		313		67		83		79		84	
Trinity wide ORI	1255		1206		855		197		214		235		209	
Trinity wide Priority 1	752		708		545		112		138		151		144	
ORI in Lowell by setting:														
Inside Private home	348	43%	327	40%	206	39%	49	37%	47	34%	42	33%	68	54%
Public location inside	55	7%	82	10%	76	15%	29	22%	18	13%	14	11%	15	12%
Public location outside	370	46%	386	48%	230	44%	50	37%	69	50%	69	54%	42	34%
Other	29	4%	16	2%	11	2%	6	4%	3	2%	2	2%	0	0%
Gender:														
Female	234	30%	224	28%	151	29%	36	27%	48	35%	33	26%	34	27%
Male	558	70%	588	72%	372	71%	98	73%	89	65%	94	74%	91	73%
Females U20	6	3%	2	1%	3	2%	1	3%	2	4%	0	0%	0	0%
Female 20-29	70	30%	78	35%	32	21%	9	25%	12	25%	5	15%	6	18%
Female 30-39	101	43%	79	35%	53	35%	15	42%	19	40%	7	21%	12	35%
Female 40 - 49	37	16%	36	16%	42	28%	8	22%	9	19%	14	42%	11	32%
Female 50- +	20	9%	29	13%	21	14%	3	8%	6	13%	7	21%	5	15%
Male U20	2	0%	2	0%	1	0%	0	0%	0	0%	0	0%	1	0%
Male 20-29	163	29%	178	30%	91	24%	33	24%	18	34%	19	20%	21	20%
Male 30- 39	194	35%	178	30%	129	35%	31	35%	29	32%	35	33%	34	37%
Male 40 - +	115	21%	124	21%	65	17%	13	17%	19	13%	19	21%	14	20%
Male 50 - +	84	15%	106	18%	86	23%	21	23%	23	21%	21	26%	21	22%

	2017 Total		2018 Total		Last 4 Qs Total		Q1 2019		Q2 2019		Q3 2019		Q4 2019	
Acre	106	13%	125	15%	63	12%	18	13%	17	12%	15	12%	13	10%
Back Central	90	11%	107	13%	82	16%	15	11%	26	19%	21	17%	20	16%
Belvidere	21	3%	17	2%	17	3%	1	1%	5	4%	5	4%	6	5%
Centralville	131	16%	109	13%	68	13%	7	5%	20	15%	14	11%	27	22%
Downtown	182	23%	204	25%	138	26%	48	36%	31	23%	34	27%	25	20%
Highlands	53	7%	48	6%	36	7%	13	10%	9	7%	8	6%	6	5%
Lower Belvidere	14	2%	21	3%	11	2%	4	3%	3	2%	2	2%	2	2%
Lower Highlands	97	12%	81	10%	51	10%	10	7%	15	11%	10	8%	16	13%
Pawtucketville	40	5%	48	6%	25	5%	6	4%	4	3%	10	8%	5	4%
Sacred Heart	50	6%	42	5%	21	4%	7	5%	6	4%	5	4%	3	2%
South Lowell	18	2%	9	1%	11	2%	5	4%	1	1%	3	2%	2	2%
Home towns of patients:														
Lowell	450	66%	487	60%	314	62%	78	58%	86	63%	74	58%	76	70%
Dracut	22	3%	39	5%	20	4%	4	3%	6	4%	7	6%	3	3%
Billerica	16	2%	26	3%	19	4%	7	5%	5	4%	3	2%	4	4%
Chelmsford	20	3%	18	2%	7	1%	2	1%	4	3%	0	0%	1	1%
Tewskbury	14	2%	16	2%	11	2%	2	1%	2	1%	3	2%	4	4%
Other/unknow	165	24%	225	28%	135	27%	41	31%	34	25%	40	31%	20	19%

ALS:	Life Support- may refer to vehicles staffed with a least one paramedic or refer to a paramedic level of patient care. Trinity Emergency ALS vehicles are staffed with two paramedics.
A Response:	Is defined as dispatching or sending an ambulance to a request for service. In this report , a response is further sorted to include only emergency responses. These numbers do not include routine transfers such as dialysis patients or radiation treatment patients.
A Transport:	Is defined as taking a patient in an ambulance to a destination.
BLS:	Basic Life Support- may refer to a vehicle staffed with two emergency medical technicians (EMT) or an EMT level of patient care. Trinity BLS ambulances are staffed with two EMT's
EMD:	Emergency Medical Dispatch- a nationally recognized system whereby dispatchers are trained and follow a specific protocol to ascertain the nature of illness/injury and provide patient care instructions to the caller until the First Responders or ambulance arrives.
Intubation Attempt:	Is defined as insertion of the laryngoscope blade into the oral cavity for the purpose of inserting an endotracheal tube.
MAI:	Medication Assisted Intubation is generally regarded as facilitating an intubation with the use of sedatives. In Massachusetts how ever, this term includes the use of Paralytics. The Massachusetts MAI program is not part of the standard scope of practice for Paramedics. It is controlled through the Department of Public Health's Office of Emergency Medical Services Medical Services Committee.
On scene time:	The amount of time that has elapsed from the moment the ambulance is on scene to the moment the ambulance begins transport or is released back into service
Out of chute time:	The amount of time that elapses from the moment when the ambulance is dispatched to the moment the ambulance begins moving towards the call.
On time performance score:	Is the percentage of calls that meet or exceed the response time criteria.
Request for service:	When a dispatcher receives request for an ambulance usually via telephone or radio
Response time:	The amount of time that has elapsed from the moment the call is completely entered into the dispatch system to the moment the ambulance arrives on scene.

RSI:	Rapid Sequence Intubation is the facilitation of intubation using both sedatives and paralytics
Service Zone Plan:	M.G.L. Part 1 Title XVL Chpt. 11C Section 1 defines as "a geographic area defined by and comprised of one or more local jurisdictions, in which a local jurisdiction may select and the department shall designate an EMS first response service and an ambulance service to provide EMD first response and primary ambulance response to the public within the defined area, pursuant to section 10." Massachusetts Regulations 105 CMR 170.249.
Transport time:	The amount of time that has elapsed from the moment the ambulances leaves the scene with a patient to the moment the ambulance arrives at the receiving facility
Triage down:	When a paramedic units arrives at the patients side and based on the patient condition determines that the patient may be treated and transported at the BS level. Note- There is no protocol for this practice, however, OEMS does address it though an administrative advisory: A/R5=620.

- The following document is a detailed outline of the reporting process used by Trinity EMS.
- **Responding lights and sirens**
  - From Lowell 911
    - All calls require a lights and sirens response regardless of the patients condition except
      - Needle pick ups
      - Pt carry down/up without a medical issue
      - Unless requested to response without lights and sirens by the 911 center.
  - Direct to Trinity calls that Trinity EMD's
    - Bravo, Charlie, Delta, and Echo go with lights and sirens
    - Alpha or Omega level calls go without lights and sirens
  - Direct to Trinity that Trinity doesn't EMD
    - Response lights and sirens for any patients. Unless the calling agency EMD'ed the call to a non-urgent level.
    - This set of calls would include call from UMASS PD, or other ambulance services.
- Incident
  - A request for or by someone within the city limits of Lowell that requires an EMS response.
  - Each request is counted as 1 incident
    - A patient that gets a BLS unit for back pain is counted as 1 incident
    - A 10 car MVC with 20 patients requiring 6 BLS, 2 ALS, and 2 helicopters is counted as 1 incident
- Responses
  - Counts the number of occurrences when EMS vehicles response lights and sirens to a call.
    - An ALS and BLS unit response to a patient with chest pain, that counts as 2 responses. (2 vehicles put their lights on)
- Times:
  - All below are from incidents
  - BLS
    - Priority 1, and 2 incident responses
    - Includes 911 and calls direct to Trinity
      - ` Any call directly to Trinity from another call center that would require an emergent response
        - (IE- Umass Lowell calls Trinity for a chest pain)
        - Any Charlie, Delta, Echo response called and EMD'ed by Trinity
    - Includes call when ALS and BLS responded as well as call when just BLS responded.
    - **Q# year# Performance score**
      - Is the created by
- Dividing the number of incidents BLS units responded to.

        - Into the number of those calls that shows a response time over 08:00 or greater
        - Calls excluded
            - Delta level calls EMD’ed by Trinity that had a total response time of greater than 07:59
- **Avg out of chute**
    - Time from Trinity designated and selected ambulance was assigned call to selected crew to the time selected vehicles starts movement towards this call
    - Excluded-
        - Any time showing more than 10 minutes is excluded as likely time stamp missing
- **Avg response time**
    - From Call saved by Trinity dispatch to time ambulance arrived at geocoded location of the call.
        - Within Trinity CAD- The call saved time is called “call taken”. This time is created after Trinity dispatch get an address, apartment, complaint, and any other info 911 passed along.
    - Excluded-
        - Charlie, delta, Echo, and Omega calls direct and EMD’ed by Trinity that result in a response time over 07:59
        - Any time showing more than 20 minutes is excludes as likely time stamp missing
- **Avg on scene time**
    - Includes only calls included above
    - Time from crew arrival on site to time vehicle:
        - Clears
        - Occupies to the hospital
    - Excluded
        - Any time showing more than 30 minutes is excludes as likely time stamp missing
- **Avg transport time**
    - Includes only calls included above
    - Time from crew: Clears or arrives to the hospital
    - Excluded
        - Any time showing more than 20 minutes is excludes as likely time stamp missing
- # of events >7:59 or greater
    - Includes any call that includes calls included from reasons earlier in the section
    - That’s response time is greater than 07:59
    - Excluded
        - Any call where the unit is canceled prior to arrival
- Called that were EMD’ed by Trinity

        - No other calls are excluded- weather, 911 call volume as examples are outliers counted and categories in the "BLS reasons over 07:59"
    - **# of events using Non Trinity BLS units**
      - Requests for ambulances to Trinity that Trinity was not able to send a BLS unit on within the State mandated 5 minute dispatch time for
        - Any 911 priority 1 or 2 call
        - Any call directly to Trinity from another call center that would require an emergent response
          - (IE- UMass Lowell calls Trinity for a chest pain)
        - Any Charlie, Delta, Echo response called and EMD'ed by Trinity
  - ALS
    - The only difference from the BLS is the ALS times start at dispatch, and not call created

- BLS Outliers:
  - For any BLS response over 07:59
    - Trinity will make note and report in this section the number of concurrent emergencies in Lowell at the time this call is created.
      - Includes 911 calls and calls direct to Trinity
      - Non-emergency and call in other cities will not be counted

- BLS Reasons over 07:59
  - For any BLS response over 07:59
    - Trinity will conduct a route cause analyses as to the reason for the response time
    - Trinity will take note and report in this section. These reasons will be grouping into 1 of the following
      - Couldn't location house/lost
      - Crew passes the geo-coded location for the address more than once without getting on arrival
    - Crew took long route
      - Crew did not take the fastest route from their dispatch location to the pickup location
    - Distance
      - Usually this is used when a
        - Dispatcher gives the call out within 60 seconds
        - The crew is enroute within 120 seconds
        - Posting is happening
        - The ambulance crew went the most direct route
        - Circumstances include
          - If there is a second call in a sector of the city before reposting. 2nd call in downtown, this ambulance to the second call has two reports a much greater distance to the patient.

        - Also the extra time could be traffic, school buses, and people not willing to move. I I
        - Gets used if none of the others fit.
    - ALSO
        - If the address is far away from one of the top 4 posting locations
            - Posting location 1 is Chelmsford and Westford
            - Posting location 2 is Bridge & W 6th
            - Posting location 3 is Callery Park
            - Posting location 4 is Mammoth and 4th
    - Far away is not defined in miles. More looking at the map and lacking a different issue this is selected.
- Dispatch chute
    - A Trinity EMS dispatch took more than 59 seconds from call saved to dispatch. This could be due to error or workload
- Highway
    - The location of the call is a highway. Accessing highway locations usually takes extra time do to divided 1 way road
- Out of Chute
    - The Trinity EMS crew took at least 120 seconds to get from a dispatched stage to the ambulance physically moving towards the call
- GPS fail
    - If our ambulance tracking program is not running we cannot prove a response time or a root cause.
- TEMS Dispatch error
    - An example of this is TEMS dispatcher entering the wrong house or address.
- Weather
    - Did weather impact posting or travel time. Usually snow/ extreme cold or heat
- 911 Call volume
- Was this call more than the 4th emergency in Lowell at this time

INDOOR AIR QUALITY REASSESSMENT

Lowell High School
Freshman Academy
40 Paige Street
Lowell, MA

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
January 2020

Background

Building:	Lowell High School, Freshman Academy (LHSFA)
Address:	40 Paige Street, Lowell, MA
Assessment Coordinated Through:	Lowell Public School Department
Reason for Request:	Reassessment based on actions taken since the previous visit in 2017.
Date of Assessment:	January 13, 2020
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Ruth Alfasso, Environmental Engineer/Inspector, Indoor Air Quality (IAQ) Program
Building Description:	The Freshman Academy building at 40 Paige Street was originally built in the 1800's and renovated in the 1930's and 1980's. The three-story brick building contains classrooms, offices, laboratory spaces, an auditorium, and other spaces.
Windows:	Openable

This school was visited previously in 2017. Two visits were made: one during the summer when the school was unoccupied and again in the fall during normal occupancy. Recommendations were made in a report following each visit. The MDPH/IAQ Program returned to the school this year for a follow-up visit, in part to assess the response to recommendations made in our previous report as well as to provide further recommendations to improve IAQ. Appendix A shows recommendations from both 2017 reports. In addition, the LHS complex will be undergoing significant renovations over the next several years. Recommendations included in this report will also address planning for renovation-related issues.

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

Table 1 shows indoor air testing results, which are summarized below.

- ***Carbon dioxide levels*** were above 800 parts per million (ppm) in most areas assessed, indicating a lack of air exchange in the building. Appendix B is an additional resource about carbon dioxide.
- ***Temperature*** was within the recommended range of 70°F to 78°F in all areas on the day of assessment.
- ***Relative humidity*** was below the recommended range of 40 to 60% in the areas tested which is typical during the heating season.
- ***Carbon monoxide*** levels were non-detectable in all areas tested.
- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality (NAAQS) limit of 35 $\mu g/m^3$ in all areas tested.

Ventilation

A heating, ventilating, and air conditioning (HVAC) system has several functions. First it provides heating and, if equipped, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but by filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. Even if an HVAC system is operating as designed, point sources of respiratory irritation may exist and cause symptoms in sensitive individuals.

Ventilation for the Freshman Academy is provided by a single air-handling unit (AHU) located on the roof. The amount of fresh air drawn into the units is controlled by moveable louvers connected to an activator motor to alter fresh air intake to help maintain temperature. Fresh air is distributed via ductwork connected to ceiling or wall-mounted diffusers in classrooms (Picture 1). Exhaust ventilation is provided by ceiling or wall-mounted grates (Picture 2) that return air back to the AHU via ductwork.

Based on air testing results, most classrooms with normal occupancy appear to have a lack of air exchange provided by the HVAC system in its current operating mode. Given the age and operation of the existing HVAC system, it may be necessary to use windows to supplement fresh air supply for classrooms where available. Although these slightly elevated levels of carbon dioxide are not hazardous, it indicates that normally occurring indoor air pollutants (e.g., odors, water vapor, and VOCs) may accumulate in these rooms. Some exhaust vents were also not functioning at the time of the assessment.

The HVAC systems should be regularly maintained and operate continuously during occupied hours. It may be possible to adjust the HVAC system to allow more fresh air into the system, e.g. by opening supply louvers or adjusting the proportion of air exhausted rather than recirculated. Exhaust ventilation should also be checked periodically to ensure a draw of air from classrooms, restrooms and other areas. In one classroom, the supply vent was blocked with duct tape (Picture 3) due to occupant concerns about drafts. In order to function properly, supply and exhaust/return vents should be unblocked.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air while removing stale air from a room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). It is unknown the last time these systems were balanced.

Microbial/Moisture Concerns

Water-damaged ceiling tiles and ceiling plaster were observed in some classrooms, offices, and hallways (Pictures 4 through 6; Table 1). Water-damaged ceiling tiles should be replaced after the leak is found and repaired. Some stained tiles resulted from historic leaks while others represent new or ongoing leaking from the roof, plumbing or HVAC system. Note that the dark stains in Picture 6 are reported to result from a leak of coolant (glycol) from the HVAC system, which may encourage mold growth. Many ceiling tiles had also been removed due to leaks. In particular, sections of tiles had been removed in the hallway. Ceiling tiles used in the hallway are interlocked, so it is very difficult to replace individual damaged tiles. Facilities staff is working on a plan to replace some of these interlocking tiles in hallways with a newer style that will be easier to replace as needed.

In general, ceiling tiles have an open space above them (the ceiling plenum) and tend to dry out quickly, reducing the chance for mold colonization. Ceiling plaster does not contain organic material; therefore, it will not support microbial growth even when frequently moistened. In some cases, dust or paint on the surface of plaster can become mold colonized. If this occurs, plaster can often be cleaned to remove the mold.

Roof leaks reportedly account for many of the observed water damage in the building. It is reported that as sections of the roof are repaired, other sections become damaged. Some leaks are in areas which suggest that flashing around windows, skylights and other penetrations are damaged and should be repaired. Water was also observed pooling on sections of the roof (Picture 7). This indicates that the roof is not draining properly. Pooling water can damage the roof membrane due to freezing and thawing action during winter months.

Measures should be taken to ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008). The US EPA and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials (e.g., ceiling tiles, gypsum wallboard) be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008; ACGIH, 1989). If not dried within this time frame they should be removed/discarded.

Indoor plants were observed in some areas (Picture 8). Plants can be a source of pollen and mold, which can be respiratory irritants to some individuals. Plants should be properly maintained and equipped with non-porous drip pans and should be located away from air diffusers to prevent the aerosolization of dirt, pollen and mold.

There appeared to be some plumbing fixtures in the LHSFA that are no longer or seldom used, including a sink in a former darkroom, toilet fixtures in what is now a janitorial closet, and some classroom sinks. When drains aren't moistened periodically, the drain traps can dry out and allow gases from the sewer into occupied areas.

Windows open in most exterior classrooms. Open windows can be an additional source of fresh air. However, windows need to be tightly closed at the end of each day to prevent water infiltration and pest intrusion.

Other Observations

Exposure to low levels of total volatile organic compounds (TVOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. To determine if VOCs were present, BEH/IAQ staff examined rooms for products containing VOCs. BEH/IAQ staff observed air fresheners, hand sanitizers, cleaners, and dry erase materials in use within the building (Table 1). A scent/essential oil diffuser was found in one classroom (Picture 9). All of these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals. Note that scented products such as air fresheners do not remove odors; they only mask odors with another scent. These products contain volatile organic compounds (VOCs) and other fragrances which may cause irritation of the eyes, nose, and respiratory system.

A set of 3-D printers and other equipment was located in the Makerspace room on the lower level (Picture 10). Apart from the laser cutter, none of this equipment has any exhaust ventilation. 3-D printers can produce plastic fumes, particulates and odors during operation and should be used in well-ventilated areas, ideally with dedicated exhaust ventilation.

In one classroom, tennis balls were used as chair glides (Picture 11). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and lead to off-gassing of VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1998).

Other issues were noted in the LHSFA. Accumulations of pencil shavings were noted in some classrooms (Picture 12; Table 1). This material can be irritating if aerosolized. Supply and return vents, personal fans and similar equipment were dusty in some areas (Picture 13). This dust can be reaerosolized when the equipment is used.

In many areas, items, including books, papers, equipment and decorative items were observed on floors, windowsills, tabletops, counters, bookcases, and desks (Table 1), which can make it more difficult for custodial staff to clean.

Most rooms in the LHSFA are not carpeted, but some carpeting and area rugs are present in the school (Picture 14). Carpeting should be cleaned regularly using a High Efficiency Particulate Arrestance (HEPA) equipped vacuum cleaner. Area rugs that are too worn or soiled to be cleaned should be discarded. Upholstered furniture and plush items should also be cleaned regularly to remove dust, debris and odors.

Conclusions/Recommendations

The following recommendations are made to assist in improving IAQ:

1. Consult Appendix A for previous recommendations from the 2017 reports that need additional work.
2. Operate all supply and exhaust ventilation equipment continuously during occupied periods.
3. If possible, increase fresh air supply to the AHU.
4. Unblock supply ventilation. Consider relocating or changing the style of supply vents to address concerns about drafts.
5. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day.
6. Check exhaust vents for air draw periodically and repair as needed. Do not block exhaust vents with furniture or items.
7. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
8. Ensure roof and plumbing leaks are repaired and replace water-damaged ceiling tiles.
9. Repair other water-damaged building materials (e.g., wall/ceiling plaster).
10. Properly maintain plants, including drip pans, to prevent water damage to porous materials. Plants should also be located away from air diffusers to prevent the aerosolization of dirt, pollen, and mold.
11. Ensure that drains for seldom-used plumbing fixtures are moistened periodically to maintain the trap seal. If fixtures are no longer needed, they should be properly abandoned (e.g. cut and capped).
12. Reduce or eliminate the use of products containing VOCs (e.g., air fresheners, scented cleaning products, and hand sanitizer).
13. Consider the installation of supplemental or direct exhaust ventilation for the 3-D printers in the Makerspace room.
14. Replace tennis balls with latex-free chair glides.
15. Ensure that all pencil sharpeners have covers and are emptied regularly to prevent distribution of irritating dusts.
16. Regularly clean supply/return/exhaust vents and fans to avoid aerosolizing accumulated particulate matter.

17. Consider reducing the amount of items stored in rooms to make cleaning easier. Periodically move items to clean flat surfaces.
18. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritation).
19. HEPA vacuum carpeting daily and clean carpeting annually (or semi-annually in soiled high traffic areas). Clean area rugs similarly. Discard area rugs that are too worn or soiled to be effectively cleaned.
20. Encourage faculty to report classroom/building related issues via a tracking program.
21. Continue to adopt the US EPA (2000) document, “Tools for Schools”, as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
22. Refer to resource manual and other related IAQ documents located on the MDPH’s website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

MDPH. 2015. Massachusetts Department of Public Health. "Indoor Air Quality Manual: Chapters I-III". Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

NIOSH. 1998. National Institute for Occupational Safety and Health. Latex Allergy A Prevention. National Institute for Occupational Safety and Health, Atlanta, GA.

SBAA. 2001. Latex In the Home And Community Updated Spring 2001. Spina Bifida Association of America, Washington, DC.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2000. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/index.html.

US EPA. 2008. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. September 2008. Available at: http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide.

Picture 1

Ceiling-mounted supply vent

Picture 2

Ceiling-mounted return vent

Picture 3

Blocked supply vent

Picture 4

Water-damaged ceiling tiles in a stairwell

Picture 5

Water-damaged ceiling tiles in a classroom

Picture 6

Dark staining on ceiling tiles, reportedly from a glycol leak from the HVAC system

Picture 7

Water pooling on a lower level section of the roof

Picture 8

Plants on a windowsill

Picture 9

Scent diffuser in a classroom

Picture 10

3-D printers in the Makerspace

Picture 11

Tennis balls as chair glides

Picture 12

Pencil shavings

Picture 13

Dusty fan

Picture 14

Area rug with debris

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Background	470	ND	44	40	7					Flurries
Upper level										
850	981	ND	73	27	4	~25	Y 1 open	Y	Y	Sinks, DEM, NC, MT (wire pulling), HS
850 inner	856	ND	73	22	3	1	Y	Y	Y	NC, WAC
853	933	ND	74	24	4	18	Y 1 open	Y	Y	DEM, MT, HS
852	924	ND	73	24	4	3	N	Y	Y	NC
852 inner workroom	983	ND	74	24	3	0	Y 1 open	Y	Y	NC, fridge, sink
janitor (old restroom)	901	ND	74	26	9	0	N	N	?	NC, toilet and sink (unused?), CP and pesticides
854 rear	794	ND	74	20	2	0	Y	Y	Y	plants, 2 WD CT
police office	789	ND	75	20	3	1	Y	Y	Y	plants, 2 WD CT (recent), NC, items

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferable > 800 ppm = indicative of ventilation problems	Temperature: Relative Humidity:	70 - 78 °F 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
staff restroom									Y	NC
855	900	ND	74	22	13	1	Y	Y	Y	NC, DEM
856	953	ND	74	22	4	0	Y 1 open	Y	Y	NC, DEM, sink
858	946	ND	75	22	5	15	Y	Y	Y	NC, DEM
857	984	ND	75	23	5	20	Y 1 open	Y	Y	NC, DEM, sinks
860	789	ND	75	20	3	0	Y	Y	Y	Many WD CT, NC
859	740	ND	74	21	2	0	Y	Y	Y	3 WD CT, HS, NC
First floor										
823	720	ND	75	20	2	0	Y	Y	Y	microwave, NC, HS, CP
821	900	ND	76	23	3	0	Y	Y	Y	sink - dripping, NC, fridge, DEM

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
820	1139	ND	77	25	3	18	Y	Y	Y	NC - missing floor tiles, PC, DEM, sink
818	1130	ND	77	25	5	20	Y	Y	Y	NC, DEM, sink
819	1139	ND	77	24	4	25	Y	Y	Y	DEM, NC, PF, plant, microwave, missing floor tiles
817	1248	ND	77	26	3	22	Y	Y	Y	NC, sink dripping, fridge, DEM, missing floor tiles
816	1030	ND	77	20	2	1	Y	Y	Y	Sink, NC, chalk, NC, missing floor tiles
women's restroom									Y	
813	1037	ND	77	21	7	13	Y	Y	Y	NC, DEM, missing floor tiles
812	1063	ND	76	21	9	25	Y 1 open	Y	Y	DEM, scent diffuser
nurses restroom		ND						Y		WD CT, CP/AF
810 computer lab	988	ND	77	22	4	20	Y 1 open	Y	Y	Computers, NC

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
811	970	ND	76	21	5	10	Y		Y	small room, TBS, PF, DEM, area rug
902	1012	ND	75	22	6	1	Y	N	Y	DEM, HS, PF, 1 WD CT, WD plaster
902A nurse	1001	ND	73	23	6	2	Y	Y	Y	NC
nurse's office	948	ND	73	23	5	0	N	Y	N	sink, 6 WD CT and 1 MT
901	902	ND	73	22	4	0	Y	Y	Y	science equipment: sinks, stove, NC, DEM
903	924	ND	72	23	6	0	Y	Y	Y	computers, MTs and WD CT, NC
904	1099	ND	73	26	9	0	Y	Y	Y	5 WD CT, NC, PF, DEM
905	1084	ND	73	24	6	0	Y	Y	Y	DEM, NC, sink
906	1049	ND	73	25	5	1	Y	Y	Y	NC, DEM, books
908	1008	ND	74	26	16	class left 10 min	Y	Y	Y	DEM, PF, NC, missing floor tiles

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
906	1159	ND	74	27	19	0	Y	Y	Y	DEM, NC
909	1087	ND	72	26	8	1	Y	Y	Y	DEM, PF, WD CT
911	1273	ND	71	27	5	0	Y	Y	Y	DEM, sink, plants
912	1118	ND	71	26	15	16	Y	Y	Y	WD CT, DEM, NC, sink
910	1191	ND	71	28	9	class just left	Y	Y	Y	DEM, NC, heater, sink, PS
724	1047	ND	73	27	6	0	Y	Y	Y	DEM, WD CT, MT
720	935	ND	73	25	5	0	Y open	Y	Y	DEM, sink, PF
723	1044	ND	71	26	5	0	Y	Y	Y	DEM, sink, NC
721	1070	ND	72	26	10	0	Y	Y	Y	NC, DEM, chalk, PS
717	977	ND	73	25	5	1	Y	Y	Y	PC, food odor, WD CT

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
717 inner	986	ND	73	25	5	4	Y	Y?	Y	dishwasher, sink
716 storage	917	ND	73	23	4	1	N	Y	Y	PF on
715	1066	ND	74	26	5	10	Y	Y	Y	NC, DEM
711	1061	ND	73	25	8	1	Y	Y	Y	NC, DEM, UF, are rug
713	1122	ND	73	26	8	0	Y	Y	Y	NC, DEM, area rug, UF, has restroom inside
714	1086	ND	74	26	7	23	Y	Y	Y	NC, DEM, has restroom
712	1069	ND	74	24	4	21	Y	Y	Y	
storage	882	ND	74	23	4	0	N			
107 conference	926	ND	73	23	4	1	Y			
Mrs. Jeffrey	845	ND	72	23	6	1	Y	Y	Y	

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
109	848	ND	73	23	14	1	Y	Y	Y	PF, usually too hot
Ms. G	893	ND	73	23	4	1	Y	Y	Y	PF on
112	888	ND	73	23	4	0	Y	Y	Y	sink
women's restroom									Y	restroom odors
main office	853	ND	74	23	3	4	Y	Y	Y	WAC
Main office call center	828	ND	75	23	4	0	Y	Y	Y	fridge and microwave
Main office conference	831	ND	75	23	3	0	N	Y	Y	sink
Main office conference/office	823	ND	76	23	3	0	Y	Y	Y	DEM
Main office (office)	823	ND	75	23	3	1	Y	Y	Y	Pop up AF, DEM
Main office (office)	834	ND	75	22	3	1	Y	Y	Y	

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School Freshman Academy **Indoor Air Results**

Address: 40 Paige Street, Lowell **Table 1** **Date: 1/13/20**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Lower Level										
706 cafeteria	933	ND	73	29	4	3	N	Y	Y	first lunch just left
704	891	ND	74	25	5	1	N	Y	Y	DEM, PF
702	896	ND	75	24	4	1	N	Y	Y	DEM, PF
701	1067	ND	76	27	4	21	N	Y	Y	broken pipe in room previously, wall opened, cleaned, no current odor
703	1495	ND	76	28	4	21	N	Y	Y	vent blocked
Auditorium	724	ND	73	21	3	0	N	Y	Y	carpet, UF
700	752	ND	73	24	3	0	Y?	Y	Y	NC, 3D printers, laser cutters, etc.

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
HS = hand sanitizer
MT = missing ceiling tile
NC = not carpeted
PC = photocopier
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

APPENDIX A
Previous Recommendations

Conclusions/Recommendations from the visit made in July of 2017

The following recommendations are made to assist in improving IAQ:

1. Operate all supply and exhaust ventilation equipment continuously during occupied periods.
2. Remove dryer sheets from supply vents.
3. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day.
4. Check exhaust vents for air draw periodically and repair as needed. Do not block exhaust vents with furniture or items.
5. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
6. Consider working with a roofing contractor to examine methods of pitching roof towards drains to prevent water pooling.
7. Ensure roof and plumbing leaks are repaired and replace water-damaged ceiling tiles.
8. Repair other water-damaged building materials (e.g., wall/ceiling plaster).
9. Repair sink backsplashes to prevent water damage. Refrain from storing porous items or large amounts of items under sinks.
10. Repair broken plumbing fixtures, or ensure water is turned off to prevent leaks.
11. Ensure that condensation from air conditioning equipment is draining properly. Check collector pans, piping and any associated pumps for clogs and leaks and clean periodically to prevent stagnant water build-up and remove debris that may provide a medium for microbial growth.
12. Use pleated filters of MERV 8 in AHUs, if these can be used with the current equipment. Ensure filters are changed 2 to 4 times a year. Thoroughly clean inside of AHU cabinets during filter changes.
13. Regularly clean/vacuum supply, exhaust/return vents and fans to avoid aerosolizing accumulated particulate matter. If soiled ceiling tiles around vents cannot be cleaned, replace.

14. Clean window air conditioner filters prior to and periodically during the cooling season.
15. Clean carpeting and area rugs regularly and discard those that are worn out or too soiled to be cleaned.
16. Encourage faculty to report classroom/building related issues via a tracking program.
17. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
18. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Conclusions/Recommendations from the visit made in December of 2017

The following recommendations are made to assist in improving IAQ:

1. Operate all supply and exhaust ventilation equipment continuously during occupied periods.
2. Increase fresh air supply to HVAC units serving areas with elevated carbon dioxide (Table 2).
3. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day.
4. Check exhaust vents for air draw periodically and repair as needed. Do not block exhaust vents with furniture or items.
5. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
6. Ensure roof and plumbing leaks are repaired and replace water-damaged ceiling tiles.
7. Repair other water-damaged building materials (e.g., wall/ceiling plaster).
8. Reduce or eliminate the use of products containing VOCs (e.g., air fresheners, scented cleaning products, and hand sanitizer).
9. Properly maintain plants, including drip pans, to prevent water damage to porous materials. Plants should also be located away from air diffusers to prevent the aerosolization of dirt, pollen, and mold.

10. Investigate rooms with temperature complaints to provide for adequate comfort of occupants and prevent negative perception of building IAQ.
11. Continue to implement the remaining recommendations from the preliminary walkthrough report (MDPH, 2017).
12. Encourage faculty to report classroom/building related issues via a tracking program.
13. Continue to adopt the US EPA (2000) document, “Tools for Schools”, as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
14. Refer to resource manual and other related IAQ documents located on the MDPH’s website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Appendix B

Carbon Dioxide and its Use in Evaluating Adequacy of Ventilation in Buildings

The Bureau of Environmental Health's (BEH) Indoor Air Quality (IAQ) Program examines indoor air quality conditions that may have an effect on building occupants. The status of the ventilation system, potential moisture problems/microbial growth and identification of respiratory irritants are examined in detail, which are described in the attached report. In order to examine the function of the ventilation system, measurements for carbon dioxide, temperature and relative humidity are taken. Carbon dioxide measurements are commonly used to assess the adequacy of ventilation within an indoor environment.

Carbon dioxide is an odorless, colorless gas. It is found naturally in the environment and is produced in the respiration process of living beings. Another source of carbon dioxide is the burning of fossil fuels. Carbon dioxide concentration in the atmosphere is approximately 250-600 ppm (Beard, 1982; NIOSH, 1987).

Carbon dioxide measurements within an occupied building are a standard method used to gauge the adequacy of ventilation systems. Carbon dioxide is used in this process for a number of reasons. Any occupied building will have normally occurring environmental pollutants in its interior. Human beings produce waste heat, moisture and carbon dioxide as by-products of the respiration process. Equipment, plants, cleaning products or supplies normally found in any building can produce gases, vapors, fumes or dusts when in use. If a building has an adequately operating mechanical ventilation system, these normally occurring environmental pollutants will be diluted and removed from the interior of the building. The introduction of fresh air both increases the comfort of the occupants and serves to dilute normally occurring environmental pollutants.

An operating exhaust ventilation system physically removes air from a room and thereby removes environmental pollutants. The operation of supply in conjunction with the exhaust ventilation system creates airflow through a room, which increases the comfort of the occupants. If all or part of the ventilation system becomes non-functional, a build up of normally occurring environmental pollutants may occur, resulting in an increase in the discomfort of occupants.

The MDPH approach to resolving indoor air quality problems in schools and public buildings is generally two-fold: 1) improving ventilation to dilute and remove environmental pollutants and 2) reducing or eliminating exposure opportunities from materials that may be adversely affecting indoor air quality. In the case of an odor complaint of unknown origin, it is common for BEH staff to receive several descriptions from building occupants. A description of odor is subjective, based on the individual's life experiences and perception. Rather than test for a potential series of thousands of chemicals to identify the unknown material, carbon dioxide is used to judge the adequacy of airflow as it both dilutes and removes indoor air environmental pollutants.

As previously mentioned, carbon dioxide is used as a diagnostic tool to evaluate air exchange by building ventilation systems. The presence of increased levels of carbon dioxide in indoor air of buildings is attributed to occupancy. As individuals breathe, carbon dioxide is exhaled. The greater the number of occupants, the greater the amount of carbon dioxide produced. Carbon dioxide concentration build up in indoor environments is attributed to inefficient or non-functioning ventilation systems. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

Carbon dioxide can be a hazard within enclosed areas with **no air supply**. These types of enclosed areas are known as confined spaces. Manholes, mines and sewer systems are examples of confined spaces. An ordinary building is not considered a confined space. Carbon dioxide air exposure limits for employees and the general public have been established by a number of governmental health and industrial safety groups. Each of these standards of air concentrations is expressed in parts per million (ppm). *Table 1* is a listing of carbon dioxide air concentrations and related health effects and standards.

The MDPH uses a guideline of 800 ppm for publicly occupied buildings (Burge et al., 1990; Gold, 1992; Norback, 1990; OSHA, 1994; Redlich, 1997; Rosenstock, 1996; SMACNA, 1998). A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Several sources indicate that indoor air problems *are significantly reduced* at 600 ppm or less of carbon dioxide (ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH, 1987). Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Air levels for carbon dioxide that indicate that indoor air quality may be a problem have been established by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). Above 1,000 ppm of carbon dioxide, ASHRAE recommends adjustment of the building's ventilation system (ASHRAE, 1989). In 2001, ASHRAE modified their standard to indicate that no more than 700 ppm above the outdoor air concentration; however 800 ppm is the level where further investigation will occur.

Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). The main effect of carbon dioxide involves its ability to displace

oxygen for the air in a confined space. As oxygen is inhaled, carbon dioxide levels build up in the confined space, with a decrease in oxygen content in the available air. This displacement of oxygen makes carbon dioxide a simple asphyxiant. At carbon dioxide levels of 30,000 ppm, severe headaches, diffuse sweating, and labored breathing have been reported. No **chronic** health effects are reported at air levels below 5,000 ppm.

Air testing is one method used to determine whether carbon dioxide levels exceed the comfort levels recommended. If carbon dioxide levels are over 800-1,000 ppm, the MDPH recommends adjustment of the building's ventilation system. The MDPH recommends that corrective measures be taken at levels above 800 ppm of carbon dioxide in office buildings or schools. (Please note that carbon dioxide levels measured below 800 ppm may not decrease indoor air quality complaints). Sources of environmental pollutants indoors can often induce symptoms in exposed individuals regardless of the adequacy of the ventilation system. As an example, an idling bus outside a building may have minimal effect on carbon dioxide levels, but can be a source of carbon monoxide, particulates and odors via the ventilation system.

Therefore, the MDPH strategy of adequate ventilation coupled with pollutant source reduction/removal serves to improve indoor air quality in a building. Please note that each table included in the IAQ assessment lists BEH comfort levels for carbon dioxide levels at the bottom (i.e. carbon dioxide levels between 600 ppm to 800 ppm are acceptable and <600 ppm is preferable). While carbon dioxide levels are important, focusing on these air measurements in isolation to all other recommendations is a misinterpretation of the recommendations made in these assessments.

Table 1: Carbon Dioxide Air Level Standards

Carbon Dioxide Level	Health Effects	Standards or Use of Concentration	Reference
250-600 ppm	None	Concentrations in ambient air	Beard, R.R., 1982 NIOSH, 1987
600 ppm	None	Few indoor air complaints, used as reference for air exchange for protection of children	ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH 1987
800 ppm	None	Used as an indicator of ventilation adequacy in schools and public buildings, used as reference for air exchange for protection of children	Mendler, 2003 Bell, A. A., 2000; NCOSP, 1998; SMACNA, 1998; EA, 1997; Redlich, 1997; Rosenstock, 1996; OSHA, 1994; Gold, 1992; Burge et al., 1990; Norback, 1990 ; IDPH, Unknown
1000 ppm	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1989
950-1300 ppm*	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1999
700 ppm (over background)	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 2001
5000 ppm	No acute (short term) or chronic (long-term) health effects	Permissible Exposure Limit/Threshold Limit Value	ACGIH, 1999 OSHA, 1997
30,000 ppm	Severe headaches, diffuse sweating, and labored breathing	Short-term Exposure Limit	ACGIH, 1999 ACGIH. 1986

* outdoor carbon dioxide measurement +700 ppm

References

ACGIH. 1986. Documentation of the Threshold Limit Values. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1998. Industrial Ventilation A Manual of Recommended Practice. 23rd Edition. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1999. Guide to Occupational Exposures-1999. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989.

ASHRAE. 1999. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1999.

ASHRAE. 2001. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-2001.

Beard, R.R. 1982. Chapter Fifty-two, Inorganic Compounds of Oxygen, Nitrogen, and Carbon. *Patty's Industrial Hygiene and Toxicology, Vol. IIc*. *3rd ed.* Clayton, G. D. & Clayton, F. E., eds. John Wiley & Sons, New York, NY.

Bright, P.; Mader, M.; Carpenter, D.; and Hermon-Cruz, I.Z. 1992. Guideline for Indoor Air Surveys. Brooks Air Force Base, TX. Armstrong Laboratory, Occupational and Environmental Health Directorate. NTIS AL-TR-1992-0016.

Burge, H. and Hoyer, M. 1990. Focus On … Indoor Air Quality. Appl. Occup. Environ. Hyg. 5(2):88.

EA. 1997. Indoor Air Quality. Environment Australia, Department of the Environment, Sport and Territories, Canberra, Australia. www.environment.gov.au/soe/1996/publications/technical/pubs/12indora.pdf

Gold, D. 1992. Indoor Air Pollution. Clinics in Chest Medicine. 13(2):224-225.

Hill, B.; Craft, B.; and Burkart, J. 1992. Carbon Dioxide, Particulates and Subjective Human Responses in Office Buildings without Histories of Indoor Air Quality Problems. Appl. Occup. Environ. Hyg. 7(2): 101-111.

IDPH. Unknown. Illinois Department of Public Health Guidelines for Indoor Air Quality. Illinois Department of Public Health, Springfield, Il. http://www.idph.state.il.us/envhealth/factsheets/indoorairqualityguide_fs.htm

Mendler, S. and Odell, W. 2003. Indoor Air Quality for the EPA. *ArchitectureWeek.* April 16, 2003. http://www.architectureweek.com/2003/0416/environment_1-2.html

NCOSP. 1998. Workplace Requirements for Safety & Health, Indoor Air Quality 3.3.3. NC Office of State Personnel, Raleigh, NC. www.osp.**state**.nc.us/emprsk/safety/handbook/5-9.pdf

NIOSH. 1987. Guidance for Indoor Air Quality Investigations. Cincinnati, OH. National Institute for Occupational Safety and Health, Hazards Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluation and Field Studies.

Norback, D.; Torgen, M.; and Edling, C. 1990. Volatile Organic Compounds, Respirable Dust, and Personal Factors Related to Prevalence and Incidence of Sick Building Syndrome in Primary Schools. British Journal of Industrial Medicine. 47:740.

OSHA. 1994. Occupational Safety and Health Administration. Indoor Air Quality (Proposed Regulation), Federal Register 59:15968-16039, (1994) Appendix A.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Redlich, C.; Sparer, J.; and Cullen, M. 1997. Sick-building Syndrome. Lancet. 349:1016.

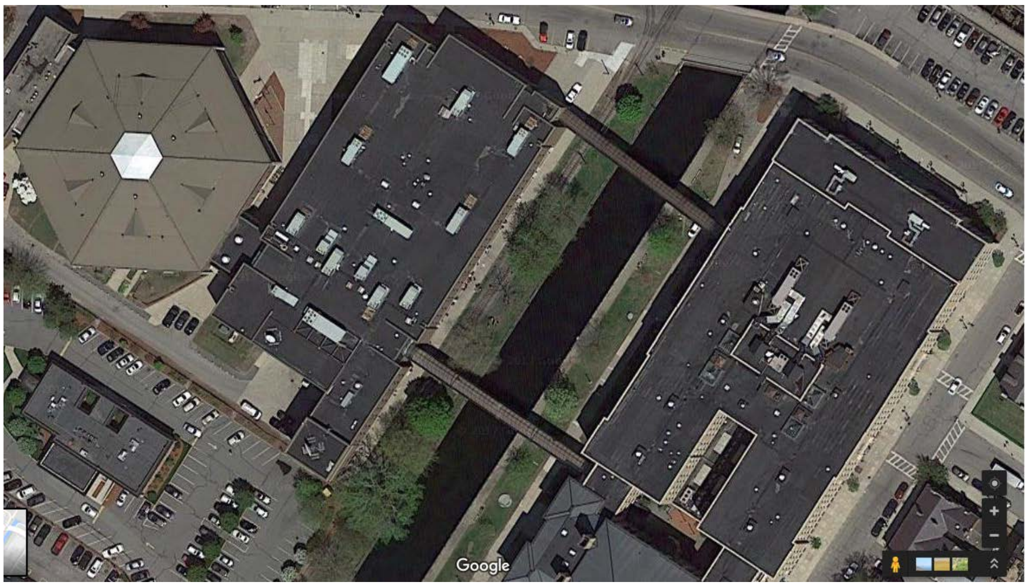
Rosenstock, L. 1996. NIOSH Testimony to the U.S. Department of Labor on Air Quality, Appl. Occup. Environ. Hyg. 11(12):1368.

SMACNA. 1998. Indoor Air Quality: A Systems Approach. 3rd ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc, Chantilly, VA. National Association, Inc.

BOH HANDOUT 1/8/20
APPENDIX B & C ADDED

INDOOR AIR QUALITY REASSESSMENT

Lowell High School
1922 Building
14 French Street
Lowell, MA



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
December 2019

Background

Building:	Lowell High School (LHS)
Address:	14 French Street, Lowell, MA
Assessment Coordinated Through:	Lowell Public Schools
Reason for Request:	Reassessment based on actions taken since the previous visit in 2017.
Date of Assessment:	October 25, 2019
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Jason Dustin, Environmental Analyst' Cory Holmes, Environmental Analyst, Ruth Alfasso, Environmental Engineer, and Mike Feeney Director, Indoor Air Quality Program (IAQ)
Building Description:	The Building at 14 French Street was built in 1922 and has brick and concrete construction in a complex shape. This building is connected to the building at 50 Father Morissette Boulevard by several enclosed walkways.
Windows:	Openable

This school was visited previously in 2017. Two visits were made: one during the summer when the school was unoccupied and again in the fall during normal occupancy. Recommendations were made in a report following each visit. The MDPH/IAQ Program returned to the school this year for a follow-up visit, in part to assess the response to recommendations made in our previous report as well as to provide further recommendations to improve IAQ. Appendix A shows recommendations from the 2017 reports. In addition, the LHS complex will be undergoing significant renovations over the next several years. Recommendations included in this report will also address planning for renovation-related issues.

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

Table 1 includes indoor air testing results, which are summarized below.

- ***Carbon dioxide levels*** were above the MDPH guideline of 800 parts per million (ppm) in more than a third of all areas assessed including all occupied classrooms, indicating a lack of air exchange in those areas of the building. Appendix B is an additional resource about carbon dioxide.
- ***Temperature*** was within or close to the recommended range of 70°F to 78°F in areas tested the day of assessment.
- ***Relative humidity*** was within or close to the lower end of the recommended range of 40 to 60% in the areas tested.
- ***Carbon monoxide*** levels were non-detectable in the areas tested.
- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality (NAAQS) limit of 35 $\mu g/m^3$ in all but four areas tested. This is discussed further in the "Other Conditions" section of the report.

Ventilation

A heating, ventilating, and air conditioning (HVAC) system has several functions. First it provides heating and, if equipped, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but by filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. Even if an HVAC system is operating as designed, point sources of respiratory irritation may exist and cause symptoms in sensitive individuals.

Fresh air is provided by multiple air-handling units (AHUs) located on the roof. These units vary in size, age, and condition. According to building facility staff, several of the units have been replaced since the 2017 visits. In general, AHUs draw fresh air through an intake vent, where the air is filtered, then heated or cooled (i.e., conditioned). The conditioned fresh air is mixed with some air returned from rooms, then supplied to rooms through supply diffusers/grates throughout the building (Pictures 1 and 2). Return vents in rooms (Picture 3) bring stale air back to the AHU where a portion of this air is exhausted through louvers in the AHU. In the basement area, some classrooms were equipped with separate AHUs/fan coil units mounted in the ceiling.

In the oldest parts of the school, remnants of the original ventilation system still exist, including the gravity exhaust vents at the base of classroom walls (Picture 4). It was not known if these vents were still connected to ductwork or to any vents on the roof. If they do not function, they should be sealed up in an airtight manner, as they could provide pathways for dust, odors and pests to travel in the building.

Based on air sampling, many classrooms with normal occupancy appeared to have a lack of air exchange provided by the HVAC system in its current operating mode. Given the age and operation of the existing HVAC system, it may be necessary to open windows during temperate weather to supplement fresh air supply for classrooms.

The HVAC systems should be regularly maintained and operate continuously during occupied hours. It may be possible to adjust AHUs to allow more fresh air into the system, e.g. by opening supply louvers or adjusting the proportion of air exhausted rather than recirculated. Exhaust ventilation should also be checked periodically to ensure a draw of air from classrooms.

It was noted that the cooking area in the basement (Room 17) lacked exhaust ventilation, which is particularly important in areas where pollutants would be generated. Levels of particulate matter were elevated in this area (Table 1) and there was an odor of cooking. In addition, at least one of the stoves uses natural gas, which can create nitrous oxides and other products of combustion.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air while removing stale air from a room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). It is unknown the last time these systems were balanced.

Microbial/Moisture Concerns

As noted in previous reports, the building was constructed with materials that, for the most part, are not susceptible to mold growth. The majority of these building sections consist of brick, concrete, tile, plaster, and glass; none of which contain carbon and are resistant to mold growth, even with chronic moistening. Hardwood is also highly resistant to microbial growth. Hardwood was observed throughout these sections in flooring, support beams, and trim.

Building renovations that occurred in later years added porous building materials such as carpeting, ceiling tiles, and gypsum wallboard. These materials contain carbon, which can support mold/microbial growth.

Carpeting is a material that can become water-damaged and colonized with mold. The MDPH/IAQ program does not recommend the use of carpeting in schools, particularly in lower levels, due to the likelihood of it becoming moistened due to spills, tracked in moisture and condensation. During the previous visits to LHS, musty odors were noted in many classrooms with carpeting found in poor condition/beyond its service life. Much of the older carpeting has been removed from the building since the 2017 visit (Table 1). Due to the construction of the flooring in this part of the school complex, which is plywood, new carpet tiles were installed rather than non-porous flooring.

Some old carpeting remains in the building, including some that is visibly stained, wrinkled, or threadbare (Picture 5; Table 1), indicating it is past its service life. The service life of carpeting in schools is approximately 10-11 years (IICRC, 2002). Aging carpet can produce fibers that can be irritating to the respiratory system. In addition, tears or lifting carpet can create tripping hazards. Carpeting should be cleaned annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning, and Restoration Certification (IICRC, 2012).

Water-damaged ceiling tiles, plaster, gypsum wallboard and flooring were observed in classrooms, offices, hallways and closets (Pictures 6 through 10; Table 1). Damage to these materials indicates leaks from the building envelope or HVAC/plumbing system. Ceiling tiles and gypsum wallboard should be replaced after a leak is found and repaired. In general, ceiling tiles have an open space above them (the ceiling plenum) and tend to dry out quickly, reducing the chance that they will be colonized with mold. Building facility staff reported that the 1920s building roof has been replaced since the last visit, so most of the observed water-damaged ceiling tiles are from historic leaks. However, a recent leak was reported in room 351. Replacement of all water-damaged ceiling tiles is planned as funds for new materials becomes available.

Measures should be taken to ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008). The US EPA and the American Conference of Governmental

Industrial Hygienists (ACGIH) recommend that porous materials (e.g., ceiling tiles, gypsum wallboard) be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008; ACGIH, 1989). If not dried within this time frame they should be removed/discarded.

In many areas, some ceiling tiles were also missing (Picture 7; Table 1). These need to be replaced to maintain a continuous ceiling plenum and prevent dust and debris from above the ceiling tiles entering occupied areas.

Water-damaged plaster, efflorescence and peeling paint was observed in a number of areas (Pictures 8 and 9; Table 1). Efflorescence is a characteristic sign of water damage to building materials such as brick, mortar, or plaster, but it is not mold growth. As moisture penetrates and works its way through mortar around brick, water-soluble compounds dissolve, creating a solution. As the solution moves to the surface of the brick or mortar, water evaporates, leaving behind white, powdery mineral deposits. This condition indicates that water from the exterior has penetrated into the building. When present, efflorescence can be readily cleaned.

A severely water-damaged floor was observed in the closet of room 105A (Picture 10). The wooden floor was springy/spongy underfoot and could serve as a safety hazard. This area should be locked/off limits until repairs can be made.

Some areas in the building are equipped with air conditioning from the AHUs. Doors between these areas and non-air-conditioned areas should be kept closed to prevent condensation of humid air on chilled surfaces. A few other areas were equipped with portable or window air conditioners (Picture 11). It is important that these units have the ability to properly drain any condensation they generate so that it does not leak and moisten building materials.

Windows are openable in most exterior classrooms. Open windows can be an additional source of fresh air. However, windows need to be tightly closed at the end of each day to prevent water infiltration and pest intrusion. Windows should not be opened in a room where air conditioning is operating.

Refrigerators were found in some classrooms and offices (Picture 12; Table 1). Refrigerators should be kept clean and free of spills and spoiled food. Refrigerators and water dispensers should not be placed in carpeted areas where spills or leaks could moisten carpeting (e.g., Picture 5).

There are sinks in some classrooms, some of which appear not to be used. There may also be unused floor drains. The trap seals in unused drains can dry out and allow sewer gas and odors into occupied areas. Seldom used drains should be wetted periodically to maintain the trap seal. Some science rooms had safety showers, which should be monitored and maintained to prevent leaks. No porous materials should be stored under or near the safety showers.

Plants were noted in a few areas, including some in carpeted areas and in poor condition (Picture 13). Plants should be well maintained, placed on non-porous drip pans, and kept away from the airstream of ventilation equipment.

Ivy was observed growing on the exterior of the building (Picture 14). Ivy can damage masonry and also holds moisture against the building, preventing it from drying and increasing the potential for water damage.

Other Conditions

Exposure to low levels of volatile organic compounds (VOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. BEH/IAQ staff examined spaces for products containing VOCs, noting cleaning products, air fresheners, hand sanitizers and dry erase materials in a number of areas throughout the space (Picture 15; Table 1). All of these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals. Other sources of total volatile organic compounds (TVOCs) include copy machines and laminators. Excess heat, odors, VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Laminators produce TVOCs and plastic odors. This equipment should be used in well-ventilated areas away from occupants.

As mentioned previously, Room 17 had an unvented stove which was observed to produce elevated particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5). In addition, the hallway outside of the network hub room on the second floor had elevated PM2.5 levels. No source of combustion could be located in this area, however MDPH/IAQ staff did note that this hallway had old, worn carpeting. It is possible that the carpeting could produce fine particulates with high foot traffic, especially if it is not regularly vacuumed. Fragrance diffusers, humidifiers, and candles can also produce elevated PM2.5 and should be eliminated from the building. Elevated PM2.5 levels can produce immediate, irritant effects upon exposure.

In many areas, items, including books, papers, and decorative items were observed on floors, windowsills, tabletops, counters, bookcases, and desks, which can make it more difficult for custodial staff to clean (Table 1). Many classrooms had personal fans and some of these had dusty blades. Many supply and exhaust vents were also observed to be dusty (Picture 3; Table 1). Dust on ventilation and fan equipment can be aerosolized when the units are activated.

Conclusions/Recommendations

The following recommendations are made to assist in improving IAQ:

1. Consult Appendix A for previous recommendations that need additional work.
2. Limit access to storage closet in room 105A, until floor repairs are made.
3. Operate supply and exhaust ventilation continuously during occupied hours. Adjust ventilation equipment (e.g. louvers, flow rates) where possible to increase fresh air, particularly to frequently used classrooms.
4. Do not block supply or exhaust vents with furniture or items. Check exhaust/return vents periodically for proper function. Where exhaust vents are switch-operated, ensure they are turned on when the room is occupied.
5. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
6. Ensure areas which generate pollutants, such as cooking areas, have operable exhaust functioning.
7. Assess the status of existing old gravity exhaust vents and seal as needed.
8. Ensure that a system of regular “Operations and Maintenance” remains in place to keep HVAC systems in proper working order.
9. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
10. Replace remaining water-damaged ceiling tiles and monitor for new leaks (e.g., room 351). Prioritize replacement of ceiling tiles with potential mold staining and in frequently-occupied areas.
11. Remove remaining water-damaged, musty, or worn carpeting. Replace with non-porous materials if possible.
12. Repair water-damaged plaster; scrape off/vacuum peeling paint and efflorescence (e.g., Pictures 8 and 9).

13. Repair/replace any other water-damaged/mold-colonized porous building materials (e.g., gypsum wallboard) in classrooms, hallways and stairwell areas.
14. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
15. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
16. Regularly inspect window and portable air conditioning units to ensure proper drainage of condensate and regular cleaning of filters.
17. Ensure that doors are closed between areas with air conditioning and areas without air conditioning, to avoid condensation of humid air on chilled surfaces.
18. Refrain from storing porous items (e.g., boxes, books, paper, clothing) directly on flooring, in below grade spaces, under sink cabinets and near safety showers to avoid microbial colonization.
19. Avoid placing refrigerators and water dispensers on carpet.
20. Clean refrigerators frequently to prevent spills and odors.
21. Trim back trees/vegetation within 5′ of the building. Remove vegetation (e.g., ivy) that is growing on the building to avoid damage to exterior from associated moisture.
22. Reduce the use of products containing fragrances and VOCs.
23. Locate photocopiers and laminators in well ventilated areas away from occupants.
24. Ensure Material Safety Sheets are available for all laboratory, maintenance and janitorial chemicals used in the building.
25. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter.
26. Consider reducing the amount of items stored in classrooms to make cleaning easier. Periodically move items to clean flat surfaces.
27. Clean any remaining carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
28. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance

(HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

29. Encourage faculty to report classroom/building related issues via a tracking program.
30. As construction on this building is planned and commences, use the guidance "Methods Used to Reduce/Prevent Exposure to Construction/Renovation Generated Pollutants in Occupied Buildings" which is included as Appendix C.
31. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
32. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

IICRC. 2002. Institute of Inspection, Cleaning and Restoration Certification. A Life-Cycle Cost Analysis for Floor Coverings in School Facilities.

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. Carpet Cleaning: FAQ.

MDPH. 2015. Massachusetts Department of Public Health. "Indoor Air Quality Manual: Chapters I-III". Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2000. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/index.html.

US EPA. 2008. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. September 2008. Available at: http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide.

Picture 1

Supply duct and vent in a classroom without suspended ceiling tile system

Picture 2

Supply vent in suspended ceiling tile system

Picture 3

Return vent, note dust and debris on grill

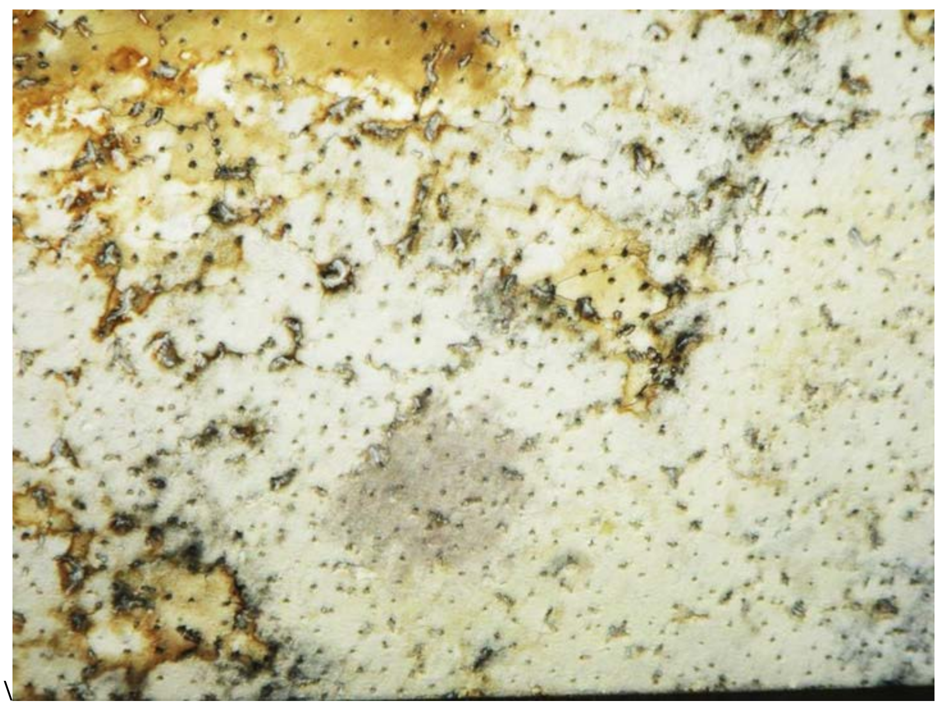
Picture 4

Old gravity exhaust vent

Picture 5

Worn, stained carpeting in a hallway, note water fountain over carpet

Picture 6



Water-damaged ceiling tile with dark staining that may indicate mold

Picture 7

Water-damaged ceiling tiles and missing tile

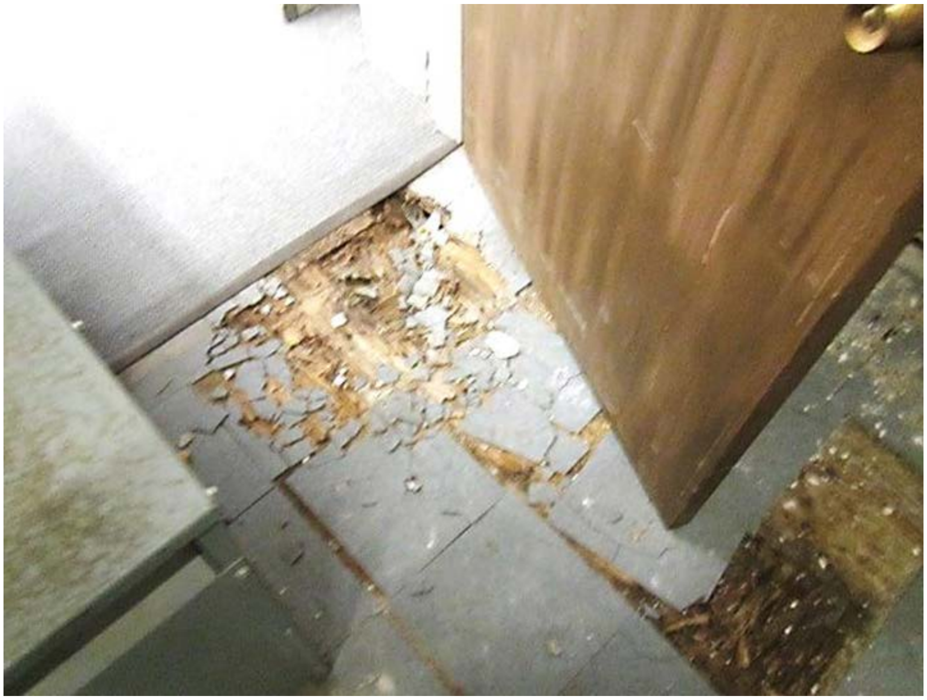
Picture 8

Water-damaged ceiling plaster

Picture 9

Water-damaged plaster, peeling paint and efflorescence in closet of room 101

Picture 10



Severely damaged floor due to water leak in closet of room 105A

Picture 11

Portable air conditioner

Picture 12

Small refrigerator on carpet

Picture 13

Plant in a carpeted area, plant was in poor condition

Picture 14

Ivy growing on the side of the building

Picture 15

Cleaning products and hand sanitizer

Location: Lowell High School 1920s building **Indoor Air Results**

Address: 14 French Street, Lowell **Table 1** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background (outside)	422	ND	59	52	12	-	-	-	-	
Third Floor										
Book room	750	ND	70	41	8	0	N	Y	Y	MT, books, some on floor
Food prep area	628	ND	71	40	7	0	Y	Y	Y	Fridges and microwave, fridge has spill
Guidance A-L	758	ND	73		9	1	Y	Y	Y	DEM, WD CT and cracked plaster
House Dean	766	ND	73	39	8	2	Y	Y	Y	WAC, carpet
Office	660	ND	71	38	8	0	N	Y	Y	Old carpet, food, PF
Open area	682	ND	71	40	7	1	Y	Y	Y	Old carpet
Open area with round tables	591	ND	71	39	7	0	Y 1 open	Y	N	Old carpet – worn, vending machines
Teachers' center										Old carpet

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Upper section office	577	ND	72	37	5	0	N	Y	Y	NC, AI
Upper section, Department Head office	635	ND	71	44	5	1	N	Y	Y	Fridge on carpet, old carpet
Upper section, office with round windows	597	ND	71	38	5	0	N	Y	Y	Dusty vents, CP, missing floor tiles
Workroom	624	ND	70	38	5	0	Y	Y	Y	New carpet, DEM
301 area office	766	ND	73	38	9	1	Y	Y	Y	WD CT (small), water cooler on carpet
301 E	776	ND	72	39	9	1	Y	Y	Y	PF, new carpet (2 years)
304A	757	ND	72	41	7	0	Y	Y	Y	NC, chalk, plants, soil, sinks
304A Closet										WD CT and MT, peeling paint
305A	749	ND	72	38	10	1 class just left	Y 1 open	Y	Y	New carpet, DEM

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable > 800 ppm = indicative of ventilation problems	Temperature: 70 - 78 °F Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
305C	642	ND	70	38	8	0	Y	Y	Y	New carpet, PF, food, CP, fridge
306 conference	651	ND	71	39	8	0	Y	Y	Y	New carpet
308	946	ND	70	47	10	3	Y	Y	Y	New carpet, WD CT, HS, PF
308 inner room	895	ND	70	44	12	0	Y	Y	Y	Dusty exhaust vents, carpet, fridge on carpet, microwave
309	782	ND	70	41	12	6	Y	Y	Y	Copy machine, new carpet, DEM
309 inner	655	ND	70	39	8	0	N	Y	Y	WD CT, boxes on floor
310	1020	ND	72	42	10	25	Y	Y	Y	Tile floor, open doors, DEM, chalk, HS
311	1130	ND	72	44	10	30 left recently	Y	Y	Y	Wood floor, DEM, old unit
312	807	ND	71	39	9	17	Y 1 open	Y	Y	Computer, old carpet, DEM
313	1159	ND	73	43	11	20	Y	Y	Y	Wood floor, DEM, sink (may be unused)

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1920s building **Indoor Air Results**

Address: 14 French Street, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
314	662	ND	73	37	8	1	Y (maybe)	Y	Y	Science room, gas spigots, NC, PS, safety shower
315	1234	ND	73	43	11	2 plus class left	Y	Y	Y	Wood floor, DEM, PF
316	1046	ND	73	41	12	12	Y 1 open	Y	Y	Old carpet, DEM, chalk, WD CT
317										Closet
318	1073	ND	72	41	13	0	Y	Y	Y	Wood floor, WD CT, chalk, DEM
319	820	ND	74	39	10	0	Y	Y	Y	DEM, wood floor
320	938	ND	73	41	11	0 class left earlier	Y	Y	Y	New carpet, DEM
321	1119	ND	74	45	12	4	Y	Y	Y	Tile and wood flooring, dusty vent, DEM
323	798	ND	74	38	10	0	Y	Y	Y	New carpet, UF, PF
323 inner	719	ND	74	37	27	0	Y	Y	Y	WAC, fridge

ppm = parts per million
µg/m³ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
324	727	ND	72	38	9	15 just left	Y	Y	Y	Older carpet – good condition, DEM, PF, AI, studio arts room
325	1031	ND	74	40	9	16	Y	Y	Y	Wood floor, DEM
326	863	ND	72	39	11	1	Y	Y	Y	HS, new carpet
330	1208	ND	72	43	18	15	Y	Y	Y	New carpet, DEM, chalk
331	798	ND	73	38	9	17	Y	Y	Y	DEM
333	920	ND	74	40	10	17	Y	Y	Y	Wood floor, PF, DEM
334	850	ND	71	40	10	15	Y	Y	Y	New carpet, DEM
338	738	ND	72	38	15	14	Y	Y	Y	Wood floor, DEM, 2 WD CT
346	691	ND	73	38	10	1	Y 1 open	Y	Y	Older carpet – stains, DEM, PF
348	824	ND	73	38	28	17	Y 1 open	Y	Y	New carpet, DEM, 2 WD CT

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
349	629	ND	75	37	8	4	Y	Y	Y	Old carpet
351	686	ND	74	36	10	13	Y 1 open	Y	Y	New carpet, WD CT (reportedly new leak), DEM
352	891	ND	73	42	36	15	Y 1 open	Y	Y	New carpet, DEM
392	1095	ND	74	40	9	15	Y	Y	Y	Wood floor, DEM, PF
Second Floor										
Mrs. Tortie	690	ND	72	45	7	0	N	Y	Y	Plants, area rug and carpet
Faculty men's room	-	-	-	-	-	-	-	-	Y off	WD ceiling
Hallway near network hub	-	-	-	-	77-111	-	-	-	-	Old carpet, high particulates
202	984	ND	71	43	10	22	Y	Y	Y	Old carpet, DEM, dusty exhaust vent
203	867	ND	72	42	13	22	Y	Y	Y	DEM, old carpet

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1920s building **Indoor Air Results**

Address: 14 French Street, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
204 A	542	ND	71	38	8	0	Y a few open	Y	Y	DEM, plant, area rug, carpet
206 A	880	ND	72	41	9	1	N	Y	Y	Carpet
206 A	712	ND	72	39	8	0	N	Y	Y	PF, carpet
206 Computer	711	ND	72	39	9	0	Y	Y	Y	Ivy outside window, carpet
207A	738	ND	71	40	9	5	Y	Y	Y	Carpet
207B	806	ND	71	41	9	0	Y	Y	Y	Carpet, several years old, DEM, dusty vents
208 A	813	ND	71	41	7	4	Y	Y	Y	Clothes
209A	987	ND	72	40	9	0	N	Y	Y	5 year old carpet, microwave
209C	744	ND	71	40	10	0	N	Y	Y	DEM
209	653	ND	70	39	9	1	Y 1 open	Y	Y	5 year old carpet, HS, DEM

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
210	1080	ND	70	51	18	26	Y	N	N	Old carpet, plants, radiators
212A	630	ND	68	44	18	26	Y open	N	N	Carpet
213	982	ND	72	44	13	19	Y open	N	N	Newer carpet, DEM, HS, plants
214A	778	ND	72	42	16	0	Y	N	N	Wood floor, PF, DEM, HS
214	-	-	-	-	-	-	-	-	-	Locked/unoccupied, old carpet
215	-	-	-	-	-	-	-	-	-	Locked/unoccupied, wood floor
216	987	ND	68	49	16	22	Y open	N	N	DEM, wood floor
217	787	ND	73	41	14	0	Y open	N	N	Newer carpet (reported: no hardwood under), Portable AC, DEM, plants, PF, HS
218	1142	ND	71	49	14	0	Y	Y off	N	Wood floor, DEM
219	1228	ND	74	44	15	20	Y	N	N	CPs, wood floor

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
220C	749	ND	70	44	15	5	Y	N	N	Carpet
223	1107	ND	73	43	16	20	Y	Y off	N	DEM, wood floor, HS
224	898	ND	72	43	16	15	Y open	N	N	Old carpet, DEM, allergy complaints
227	1321	ND	74	46	16	24	Y	N	N	DEM, wood floor
229	963	ND	73	43	17	9	Y	N	N	Carpet, DEM
231	979	ND	73	42	14	15 leaving	Y	N	N	DEM, hardwood floor, PF
235	773	ND	73	40	13	10	Y open	N	N	HS, wood floor, DEM, plants
237	-	-	-	-	-	-	-	-	-	Locked/unoccupied, hardwood, computer lab
239	566	ND	72	40	14	1	Y	Y off	Y off	HS
249	1183	ND	74	45	17	50	Y	Y off	N	Hosting large presentation, reports of mice, AHU inactive due to leaks/loud noise, carpet

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
251	994	ND	74	42	39	0	Y	Y off	Y off	Old carpet, HS, mini fridge, DEM
254	689	ND	71	43	14	0	Y	Y	Y	Old carpet, DEM
First Floor										
Auditorium	680	ND	73	38	7	~50	N	Y	Y	Some carpet
101	782	ND	71	42	8	21	Y	Y	Y	3 WD CT, WD plaster in closet, DO
102	852	ND	73	40	5	20	Y	Y	Y	Carpet, DO
104	890	ND	73	41	6	25	Y	Y	Y	Carpet, DO
105A	751	ND	71	43	8	20	Y	Y	Y	WD wall plaster (former leak), WD wooden floor in closet (potential tripping/safety hazard)
106A	551	ND	74	38	4	0	Y	Y	Y	Carpet, AC, WD windowsill
107	555	ND	70	39	7	24	Y	Y	Y	Carpet

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
109	947	ND	72	43	8	24	Y	Y	Y	Carpet
110	778	ND	71	42	7	16	Y	Y	Y	
112	515	ND	71	39	5	0	Y	Y	Y	Carpet
113	584	ND	70	41	6	7	Y Open	Y	Y	Carpet
114	926	ND	72	43	8	6	Y	Y	Y	
115	1159	ND	72	45	8	17	Y Open	Y	Y	DO
116	702	ND	71	41	9	2	Y	Y	Y	Carpet, DO
117	613	ND	70	40	9	12	Y Open	Y	Y	Carpet
118	812	ND	72	43	8	6	Y	Y	Y	DO
119	1048	ND	70	40	8	18	Y Open	Y	Y	

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
120	658	ND	72	40	7	6	Y	Y	Y	Carpet, DO
120C	545	ND	71	39	7	0	Y	Y	Y	Carpet
120F	573	ND	70	41	8	1	N	Y Door	Y	Exhaust not drawing, PF, DO
120G	634	ND	70	41	8	0	N	Y Door	N	
121	635	ND	70	41	7	0	Y	Y	Y	Old/soiled carpet, small fridge, toaster, microwave
122	959	ND	72	43	8	5	Y	Y	Y	Carpet
123	874	ND	70	39	8	19	Y	Y	Y	PF
125	1065	ND	71	46	8	6	Y	Y	Y	
126B	773	ND	73	40	7	1	Y	Y	Y	
128	875	ND	72	41	8	13	Y	Y	Y	DO

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable > 800 ppm = indicative of ventilation problems	Temperature: 70 - 78 °F Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
131	541	ND	71	39	7	0	Y Open	Y	Y	Old/worn carpet, PF, HS, AF
132	909	ND	73	42	8	22	Y	Y	Y	DO
133	663	ND	70	41	9	23	Y Open	Y	Y	Carpet, DO
134	564	ND	72	45	8	3	Y	Y	Y	
135 Stage	768	ND	73	40	8	10	N	Y	Y	
136	858	ND	74	42	7	21	Y	Y	Y	
137	768	ND	71	41	7	7	Y	Y	Y	DO
139	755	ND	73	41	9	17	Y Open	Y	Y	Carpet, DO
142	679	ND	70	39	9	22	Y	Y	Y	Carpet stain, 3 WD CTs
144	515	ND	73	37	9	4	Y	Y	Y	MT, WD CT, DO

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
145	620	ND	73	38	7	14	Y	Y	Y	Cracked window, carpet, MT, 4 WD CT
147	905	ND	73	43	8	23	Y	Y	Y	2 windows inoperable, DO, carpet, plants, PF-dusty, WD CT
Basement										
001	966	ND	71	46	6	28	Y	Y	Y	1 MT, 1 WD CT
002	916	ND	71	46	8	0	Y	Y	Y	
003	567	ND	70	40	4	4	Y	Y	Y	3 MT, 1 WD CT
005	659	ND	70	44	8	6	N	Y	Y	
007	672	ND	72	41	9	1	N	Y	Y	Carpet
008	693	ND	71	44	8	0	Y	Y	Y	
009	635	ND	71	43	17	5	N	Y	Y	Restaurant

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
009 kitchen	651	ND	72	49	25	30+	N	Y	Y	
012	765	ND	70	47	8	8	Y	Y	Y	8 WD CT
013	683	ND	71	41	5	0	Y	Y	Y	1 WD CT
014	597	ND	69	45	5	2	Y	Y	Y	Carpet
015	613	ND	71	41	3	0	N	Y	Y	
016	713	ND	70	46	7	11	N	Y	Y	
017	1148	ND	73	53	175	13	Y	Y	Y	Cooking, stoves, no exhaust, 1 stove gas-fired
018	723	ND	72	48	2	1	N	Y	Y	
019	910	ND	72	49	16	0	Y	Y	Y	Cooking odors
020	766	ND	72	45	5	5	Y	Y	Y	Tennis balls as glides

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
021	1020	ND	71	48	5	4	Y	Y	Y	Carpet
022	782	ND	72	43	6	2	Y	Y	Y	
024	657	ND	73	42	13	0	Y	Y	Y	Ajar CT, carpet
028	536	ND	72	41	4	0	Y	Y	Y	Carpet, 3 WD CT
029	900	ND	73	44	12	50+	Y	Y	Y	Carpet
030	596	ND	72	42	7	0	Y	Y	Y	Carpet
037	513	ND	70	44	6	0	Y	Y	Y	Carpet
039	838	ND	72	46	15	22	Y	Y	Y	Carpet
Band meeting room	531	ND	73	39	6	3	Y	Y	Y	
ROTC	693	ND	71	44	9	2	Y	Y	Y	7 WD CT

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1920s building **Indoor Air Results**

Address: 14 French Street, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Storage	682	ND	72	44	22	0	N	Y	Y	5 ajar CT

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
AF = air freshener
AHU = air handling unit
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO = door open
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PF = personal fan
UF = upholstered furniture
WAC = window air conditioner
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

APPENDIX A
Previous Recommendations

Conclusions/Recommendations from the visit made in July of 2017

The following recommendations are made to assist in improving IAQ:

33. Remove any water-damaged, musty, or worn carpeting. Alternative floor coverings should be explored for below grade areas as carpeting is not recommended.
34. Replace any water-damaged/mold-colonized porous building materials (e.g., ceiling tiles, gypsum wallboard) in classrooms, hallways and stairwell areas. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
35. Consult with an HVAC contractor to thoroughly examine all HVAC system components to ensure proper function. Make any necessary repairs to ensure the system is working as designed.
36. Ensure that a system of regular "Operations and Maintenance" remains in place to keep HVAC systems in proper working order.
37. Operate all supply and exhaust ventilation equipment continuously during occupied periods. Do not block supply or exhaust vents with furniture or items.
38. Consult with a roofing contractor to assess the roof membrane and underlayment/decking system. Repairs should be made to stop leaks and chronic water damage to building materials. The roofing system should then be monitored regularly for water pooling, leaks, and other deteriorating conditions.
39. Roof drains should be inspected regularly to remove any debris to avoid clogging/pooling.
40. Exterior HVAC ductwork should be inspected to find any missing or damaged insulation or unintended gaps which may allow moisture or pests to be introduced into the ductwork. Perform any necessary repairs. This would also include adding the "candy cane" vent covers to the exhaust louvres open to the elements.
41. Inspect and repair/replace any fresh air intakes that have missing or damaged bird screens or pre-filters.

42. Consult with a building engineer to inspect the building envelope to address any areas of water intrusion (e.g., windows, brickwork/mortar, flashing). This would include the brickwork noted with efflorescence and the spalling parapet.
43. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
44. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
45. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
46. Ensure any plumbing leaks are repaired to avoid chronic water damage in the building.
47. Repair sinks and sink backsplashes in classrooms.
48. Regularly add water to any fixtures/drains that are out of order or are rarely used to avoid dry drain traps. Make necessary repairs or if fixtures are deemed unnecessary they should be properly abandoned and capped.
49. Ensure that condensation from AHU equipment is draining properly. Check collector pans, piping and any associated pumps for clogs and leaks and clean periodically to prevent stagnant water build-up and remove debris that may provide a medium for microbial growth.
50. Regularly inspect window and portable air conditioning units to ensure proper drainage of condensate and regular cleaning of filters.
51. Ensure that doors are closed between areas with air conditioning and areas without air conditioning, to avoid condensation of humid air on chilled surfaces.
52. Refrain from storing porous items (e.g., boxes, books, paper, clothing) directly on flooring, in below grade spaces, or under sink cabinets to avoid microbial colonization.
53. Trim back trees/vegetation within 5′ of the building. Remove any vegetation (e.g., ivy) that is growing on the building to avoid damage to exterior from associated moisture.
54. Consider utilizing MERV 8 filters in AHUs. Check with manufacturer’s recommendations before changing filter efficiency. Continue to change filters 2-4 times a year.
55. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter.

56. Clean any remaining carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
57. Replace/repair fluorescent light covers; ensure fluorescent lights are fully secured to prevent breakage and clean debris out of covers.
58. Encourage faculty to report classroom/building related issues via a tracking program.
59. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
60. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Conclusions/Recommendations from the visit made in December of 2017

1. For information regarding the roof and recommendations, please refer to the August 2017 IAQ assessment.
2. Remove any water-damaged, musty, or worn carpeting and replace with non-porous flooring in classrooms and below-grade areas.
3. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
4. Consult with an HVAC contractor to thoroughly examine all HVAC system components to ensure proper function. Make any necessary repairs to ensure the system is working as designed. Assess whether adjustments can be made to allow more fresh air into the system.
5. Operate all supply and exhaust ventilation equipment continuously during occupied periods. Do not block supply or exhaust vents with furniture or items. Check exhaust/return vents periodically for proper function. Where exhaust vents are switch-operated, ensure they are turned on when the room is occupied.

6. Ensure areas which generate pollutants, such as cooking class areas, have operable exhaust functioning.
7. Ensure that a system of regular "Operations and Maintenance" remains in place to keep HVAC systems in proper working order.
8. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
9. Repair water leaks in Room 105A. Repair plaster once water leak once repaired.
10. Replace any water-damaged/mold-colonized porous building materials (e.g., ceiling tiles, gypsum wallboard) in classrooms, hallways and stairwell areas. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
11. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
12. Ensure that a system of regular "Operations and Maintenance" remains in place to keep HVAC systems in proper working order.
13. Ensure pipe leak in room 113 is repaired.
14. Regularly inspect window and portable air conditioning units to ensure proper drainage of condensate and regular cleaning of filters.
15. Ensure that doors are closed between areas with air conditioning and areas without air conditioning, to avoid condensation of humid air on chilled surfaces.
16. Refrain from storing porous items (e.g., boxes, books, paper, clothing) directly on flooring, in below grade spaces, or under sink cabinets to avoid microbial colonization.
17. Trim back trees/vegetation within 5′ of the building. Remove any vegetation (e.g., ivy) that is growing on the building to avoid damage to exterior from associated moisture.
18. Reduce the use of products containing VOCs.
19. Locate photocopiers and laminators in well ventilated areas away from occupants.
20. Ensure Material Safety Sheets are available for all laboratory, maintenance and janitorial chemicals used in the building.
21. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter.
22. Consider reducing the amount of items stored in classrooms to make cleaning easier. Periodically move items to clean flat surfaces.

23. Clean any remaining carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
24. Encourage faculty to report classroom/building related issues via a tracking program.
25. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
26. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Appendix B

Carbon Dioxide and its Use in Evaluating Adequacy of Ventilation in Buildings

The Bureau of Environmental Health's (BEH) Indoor Air Quality (IAQ) Program examines indoor air quality conditions that may have an effect on building occupants. The status of the ventilation system, potential moisture problems/microbial growth and identification of respiratory irritants are examined in detail, which are described in the attached report. In order to examine the function of the ventilation system, measurements for carbon dioxide, temperature and relative humidity are taken. Carbon dioxide measurements are commonly used to assess the adequacy of ventilation within an indoor environment.

Carbon dioxide is an odorless, colorless gas. It is found naturally in the environment and is produced in the respiration process of living beings. Another source of carbon dioxide is the burning of fossil fuels. Carbon dioxide concentration in the atmosphere is approximately 250-600 ppm (Beard, 1982; NIOSH, 1987).

Carbon dioxide measurements within an occupied building are a standard method used to gauge the adequacy of ventilation systems. Carbon dioxide is used in this process for a number of reasons. Any occupied building will have normally occurring environmental pollutants in its interior. Human beings produce waste heat, moisture and carbon dioxide as by-products of the respiration process. Equipment, plants, cleaning products or supplies normally found in any building can produce gases, vapors, fumes or dusts when in use. If a building has an adequately operating mechanical ventilation system, these normally occurring environmental pollutants will be diluted and removed from the interior of the building. The introduction of fresh air both increases the comfort of the occupants and serves to dilute normally occurring environmental pollutants.

An operating exhaust ventilation system physically removes air from a room and thereby removes environmental pollutants. The operation of supply in conjunction with the exhaust ventilation system creates airflow through a room, which increases the comfort of the occupants. If all or part of the ventilation system becomes non-functional, a build up of normally occurring environmental pollutants may occur, resulting in an increase in the discomfort of occupants.

The MDPH approach to resolving indoor air quality problems in schools and public buildings is generally two-fold: 1) improving ventilation to dilute and remove environmental pollutants and 2) reducing or eliminating exposure opportunities from materials that may be adversely affecting indoor air quality. In the case of an odor complaint of unknown origin, it is common for BEH staff to receive several descriptions from building occupants. A description of odor is subjective, based on the individual's life experiences and perception. Rather than test for a potential series of thousands of chemicals to identify the unknown material, carbon dioxide is used to judge the adequacy of airflow as it both dilutes and removes indoor air environmental pollutants.

As previously mentioned, carbon dioxide is used as a diagnostic tool to evaluate air exchange by building ventilation systems. The presence of increased levels of carbon dioxide in indoor air of buildings is attributed to occupancy. As individuals breathe, carbon dioxide is exhaled. The greater the number of occupants, the greater the amount of carbon dioxide produced. Carbon dioxide concentration build up in indoor environments is attributed to inefficient or non-functioning ventilation systems. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

Carbon dioxide can be a hazard within enclosed areas with **no air supply**. These types of enclosed areas are known as confined spaces. Manholes, mines and sewer systems are examples of confined spaces. An ordinary building is not considered a confined space. Carbon dioxide air exposure limits for employees and the general public have been established by a number of governmental health and industrial safety groups. Each of these standards of air concentrations is expressed in parts per million (ppm). *Table 1* is a listing of carbon dioxide air concentrations and related health effects and standards.

The MDPH uses a guideline of 800 ppm for publicly occupied buildings (Burge et al., 1990; Gold, 1992; Norback, 1990; OSHA, 1994; Redlich, 1997; Rosenstock, 1996; SMACNA, 1998). A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Several sources indicate that indoor air problems *are significantly reduced* at 600 ppm or less of carbon dioxide (ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH, 1987). Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Air levels for carbon dioxide that indicate that indoor air quality may be a problem have been established by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). Above 1,000 ppm of carbon dioxide, ASHRAE recommends adjustment of the building's ventilation system (ASHRAE, 1989). In 2001, ASHRAE modified their standard to indicate that no more than 700 ppm above the outdoor air concentration; however 800 ppm is the level where further investigation will occur.

Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). The main effect of carbon dioxide involves its ability to displace

oxygen for the air in a confined space. As oxygen is inhaled, carbon dioxide levels build up in the confined space, with a decrease in oxygen content in the available air. This displacement of oxygen makes carbon dioxide a simple asphyxiant. At carbon dioxide levels of 30,000 ppm, severe headaches, diffuse sweating, and labored breathing have been reported. No **chronic** health effects are reported at air levels below 5,000 ppm.

Air testing is one method used to determine whether carbon dioxide levels exceed the comfort levels recommended. If carbon dioxide levels are over 800-1,000 ppm, the MDPH recommends adjustment of the building's ventilation system. The MDPH recommends that corrective measures be taken at levels above 800 ppm of carbon dioxide in office buildings or schools. (Please note that carbon dioxide levels measured below 800 ppm may not decrease indoor air quality complaints). Sources of environmental pollutants indoors can often induce symptoms in exposed individuals regardless of the adequacy of the ventilation system. As an example, an idling bus outside a building may have minimal effect on carbon dioxide levels, but can be a source of carbon monoxide, particulates and odors via the ventilation system.

Therefore, the MDPH strategy of adequate ventilation coupled with pollutant source reduction/removal serves to improve indoor air quality in a building. Please note that each table included in the IAQ assessment lists BEH comfort levels for carbon dioxide levels at the bottom (i.e. carbon dioxide levels between 600 ppm to 800 ppm are acceptable and <600 ppm is preferable). While carbon dioxide levels are important, focusing on these air measurements in isolation to all other recommendations is a misinterpretation of the recommendations made in these assessments.

Table 1: Carbon Dioxide Air Level Standards

Carbon Dioxide Level	Health Effects	Standards or Use of Concentration	Reference
250-600 ppm	None	Concentrations in ambient air	Beard, R.R., 1982 NIOSH, 1987
600 ppm	None	Few indoor air complaints, used as reference for air exchange for protection of children	ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH 1987
800 ppm	None	Used as an indicator of ventilation adequacy in schools and public buildings, used as reference for air exchange for protection of children	Mendler, 2003 Bell, A. A., 2000; NCOSP, 1998; SMACNA, 1998; EA, 1997; Redlich, 1997; Rosenstock, 1996; OSHA, 1994; Gold, 1992; Burge et al., 1990; Norback, 1990 ; IDPH, Unknown
1000 ppm	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1989
950-1300 ppm*	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1999
700 ppm (over background)	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 2001
5000 ppm	No acute (short term) or chronic (long-term) health effects	Permissible Exposure Limit/Threshold Limit Value	ACGIH, 1999 OSHA, 1997
30,000 ppm	Severe headaches, diffuse sweating, and labored breathing	Short-term Exposure Limit	ACGIH, 1999 ACGIH. 1986

* outdoor carbon dioxide measurement +700 ppm

References

ACGIH. 1986. Documentation of the Threshold Limit Values. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1998. Industrial Ventilation A Manual of Recommended Practice. 23rd Edition. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1999. Guide to Occupational Exposures-1999. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989.

ASHRAE. 1999. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1999.

ASHRAE. 2001. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-2001.

Beard, R.R. 1982. Chapter Fifty-two, Inorganic Compounds of Oxygen, Nitrogen, and Carbon. *Patty's Industrial Hygiene and Toxicology, Vol. IIc*. *3rd ed.* Clayton, G. D. & Clayton, F. E., eds. John Wiley & Sons, New York, NY.

Bright, P.; Mader, M.; Carpenter, D.; and Hermon-Cruz, I.Z. 1992. Guideline for Indoor Air Surveys. Brooks Air Force Base, TX. Armstrong Laboratory, Occupational and Environmental Health Directorate. NTIS AL-TR-1992-0016.

Burge, H. and Hoyer, M. 1990. Focus On … Indoor Air Quality. Appl. Occup. Environ. Hyg. 5(2):88.

EA. 1997. Indoor Air Quality. Environment Australia, Department of the Environment, Sport and Territories, Canberra, Australia.
www.environment.gov.au/soe/1996/publications/technical/pubs/12indora.pdf

Gold, D. 1992. Indoor Air Pollution. Clinics in Chest Medicine. 13(2):224-225.

Hill, B.; Craft, B.; and Burkart, J. 1992. Carbon Dioxide, Particulates and Subjective Human Responses in Office Buildings without Histories of Indoor Air Quality Problems. Appl. Occup. Environ. Hyg. 7(2): 101-111.

IDPH. Unknown. Illinois Department of Public Health Guidelines for Indoor Air Quality. Illinois Department of Public Health, Springfield, Il.
http://www.idph.state.il.us/envhealth/factsheets/indoorairqualityguide_fs.htm

Mendler, S. and Odell, W. 2003. Indoor Air Quality for the EPA. *ArchitectureWeek.* April 16, 2003. http://www.architectureweek.com/2003/0416/environment_1-2.html

NCOSP. 1998. Workplace Requirements for Safety & Health, Indoor Air Quality 3.3.3. NC Office of State Personnel, Raleigh, NC. www.osp.**state**.nc.us/emprsk/safety/handbook/5-9.pdf

NIOSH. 1987. Guidance for Indoor Air Quality Investigations. Cincinnati, OH. National Institute for Occupational Safety and Health, Hazards Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluation and Field Studies.

Norback, D.; Torgen, M.; and Edling, C. 1990. Volatile Organic Compounds, Respirable Dust, and Personal Factors Related to Prevalence and Incidence of Sick Building Syndrome in Primary Schools. British Journal of Industrial Medicine. 47:740.

OSHA. 1994. Occupational Safety and Health Administration. Indoor Air Quality (Proposed Regulation), Federal Register 59:15968-16039, (1994) Appendix A.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Redlich, C.; Sparer, J.; and Cullen, M. 1997. Sick-building Syndrome. Lancet. 349:1016.

Rosenstock, L. 1996. NIOSH Testimony to the U.S. Department of Labor on Air Quality, Appl. Occup. Environ. Hyg. 11(12):1368.

SMACNA. 1998. Indoor Air Quality: A Systems Approach. 3rd ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc, Chantilly, VA. National Association, Inc.

Appendix C

Commonwealth of Massachusetts
Department of Public Health
Helping People Lead Healthy Lives In Healthy Communities

BUREAU OF ENVIRONMENTAL HEALTH

Indoor Air Quality Program

Methods Used to Reduce/Prevent Exposure to Construction/Renovation Generated Pollutants in Occupied Buildings

November 2006

Among the most serious indoor air quality health issues is the potential exposure to construction/renovation-generated pollutants in occupied buildings. The renovation of occupied buildings provides a number of potential exposure opportunities to pollutants. Demolition of the building materials can provide exposure to mold, asbestos, lead, bird waste and other respiratory irritants. The application of tile adhesive, roofing materials, paints and other products used during renovations provide point sources of volatile organic compounds (VOCs) and other irritating chemicals. Contractors frequently use fossil fueled construction and heating equipment in indoor areas undergoing renovations. Combustion products (e.g. carbon monoxide) can migrate into occupied areas. The impact of construction/renovation pollutants on occupied areas can be evaluated through air monitoring for VOCs, airborne particles and products of combustion. Preventing and/or minimizing exposure to construction/renovation-generated pollutants is essential to reduce indoor air-related symptoms in building occupants.

In 1999, the State Department of Education (DOE) amended their regulations to require that state funded construction projects follow established guidelines to prevent exposure of building occupants to construction/renovation pollutants. Subsequently, Chapter 208 of the Acts of 2004 transferred responsibility for the School Building Assistance Program from the DOE to the Massachusetts School Building Authority (MSBA). On September 6, 2006, the MSBA enacted regulations that require that schools receiving funds under the program for construction or renovation projects must confer with the most current edition of the "IAQ Guidelines for Occupied Buildings Under Construction" published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 963 CMR 2.04(2)(c),(d).

The MDPH has prepared this guidance in order to prevent/reduce the migration of renovation-generated pollutants into occupied areas and their potential impact on indoor air quality. The MDPH suggests that the following steps be taken on any renovation project within a public building.

Physical Isolation of Occupied Areas from Renovation Areas

Renovations of buildings should be separated from occupied areas by constructing temporary physical barriers. These barriers are typically constructed of plywood and polyethylene plastic built in or over passageways between the construction area and the occupied spaces. Construction barriers should be sealed with polyethylene plastic and duct tape on the construction side as well as the occupied side to provide a duel barrier. Inspection of these barriers should be conducted daily prior to commencement of construction activities to ensure integrity. A log of the location and condition of each barrier should be maintained in a log book.

Other migratory pathways for pollutants to move between construction and occupied areas should be examined and sealed. These migratory pathways may include but are not limited to:

- Crawlspaces
- Electrical outlets and light switches in shared walls
- Pipe and electrical conduits between walls
- Ventilation system ductwork
- Holes in interior walls and/or spaces above interior walls and roof/floor decking (e.g., spaces above ceiling tile systems).

Outdoor construction-generated pollutants can migrate indoors under various conditions. The following are recommendations to reduce migration of *outdoor* pollutants to the indoor environment:

- Seal around exterior doors with weather stripping and door sweeps to prevent infiltration of outdoor construction-generated pollutants.
- Cover with tarps any dirt/debris piles in close proximity to the building or wet down dirt/debris to decrease aerosolization of particulates, when possible.
- Change HVAC filters more regularly in areas impacted by renovation activities. Upgrading to more efficient filters for these units should also be considered.
- Temporarily deactivate the HVAC system during construction generating high amounts of outdoor pollutants. If activity is longer than one day, alternative means of ventilation should be provided for the impacted areas. If not feasible, relocation of activities in these areas should be considered.

The Use of Pressurization/Depressurization Techniques

Construction sites should be isolated and depressurized compared with occupied areas to control for renovation pollutants. To achieve depressurization, use fans to draw air away from occupied areas. Use of the existing supply ventilation system to introduce fresh outside air into occupied space should be used to increase air pressure in occupied areas adjacent to construction activities. In order to assess whether depressurization has occurred, air pressure monitoring (using a micromanometer) to measure air pressure differential between occupied space and construction areas should be used. Monitoring should be done daily at each barrier to ensure appropriate pressurization. Results of the location, dates and results of air pressure monitoring should be kept in a log book. No construction work should occur in areas immediately adjacent to occupied areas if:

- Depressurization is not achieved,
- Air pressure monitoring has not been done that day, or
- Odor/construction related complaints have been made by occupants in adjacent areas.

Operation of the Existing Ventilation Systems

Precautions should be taken to avoid the *re-entrainment* of construction-related materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities and contingency plans to maintain adequate supply of fresh air and temperature must also be developed and implemented to maintain building occupant safety and comfort. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and using filters with a higher dust spot efficiency where needed.

Administrative Management to Prevent Exposure to Construction Generated Pollutants

Various administrative actions can also prevent occupant exposures to construction/renovation-generated pollutants. The following measures should be used to prevent, eliminate or reduce occupant exposure to construction-generated pollutants:

- Schedule projects that produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.
- Develop a notification system for building occupants to report construction/renovation related odors and/or dust problems to the building administrator. These concerns should be relayed to the contractor in a manner to allow for a timely remediation of the problem.
- Disseminate scheduling itinerary to all affected parties; this can be done in the form of meetings, newsletters or weekly bulletins.
- Notify occupants about construction activities that may be conducted in close proximity to their work areas. In certain cases, HVAC equipment for areas adjacent to construction activities may need to be deactivated and windows closed periodically to prevent unfiltered air and vehicle exhaust from entering the building. For this reason, prior notification(s) should be made.
- If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from areas of renovations.
- Keep Material Safety Data Sheets (MSDS) for all construction materials used during renovations in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act.

Appendix C

Control/Reduction of Pollutants in Occupied Areas

Frequently, renovations include the replacement of components of the HVAC system, rendering windows as the only source of fresh air. In this environment, removal of normally occurring pollutants as well as construction-generated pollutants must be enhanced to reduce exposure.

The following recommendations are made to reduce exposure under these circumstances:

- Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. This should include daily cleaning of occupied areas during the course of renovation work generating dust, fumes and other particulate materials.
- Consider increasing the number of personnel or work hours for existing staff (e.g., before school) to provide increased cleaning of dirt/dust accumulation in occupied areas due to construction/renovation activities.
- Control for dusts by using a high efficiency particulate air filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping/mopping of all surfaces.
- Cover with tarps any dirt/debris piles (indoors and outdoors) in close proximity to the building or wet down dirt/debris (outdoors) to decrease aerosolization of particulates, when possible.
- Change HVAC filters more regularly in areas impacted by renovation activities. Upgrading to more efficient filters for these units should also be considered.

Inspection upon Request

The Massachusetts Department of Public Health, Bureau of Environmental Health, Indoor Air Quality Program, is available to inspect a public building upon receipt of a written request for inspection from and in cooperation with the appropriate government agency.

QUESTIONS

If you have any questions concerning these guidelines, please contact:

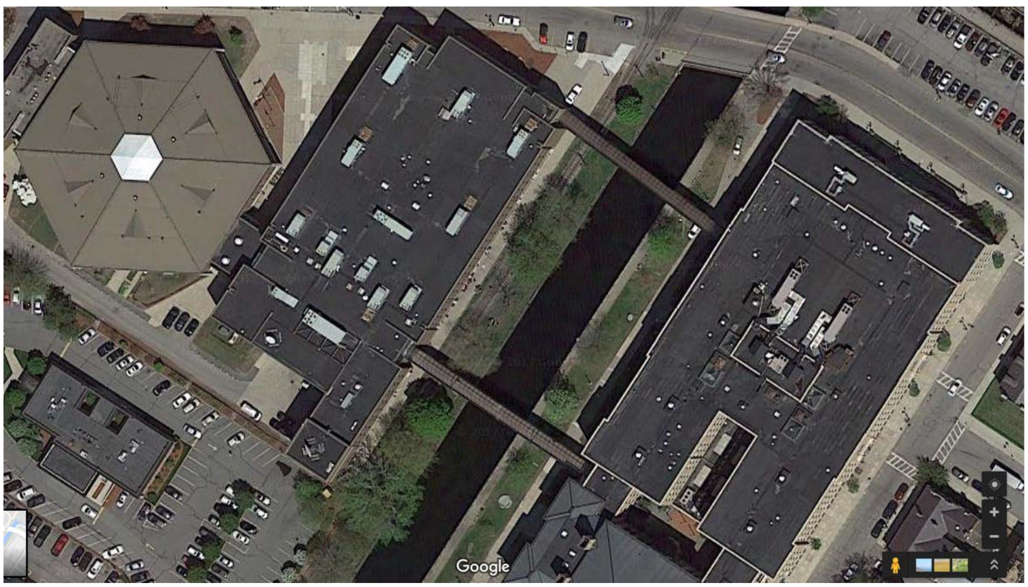
Massachusetts Department of Public Health
Bureau of Environmental Health, Indoor Air Quality Program
250 Washington Street, 7th Floor
Boston, MA 02108
Phone: (617) 624-5757 Fax: (617) 624-5777

Document Reviewed: August 2008

BOH HANDOUT 1/8/20
APPENDIX B & C ADDED

INDOOR AIR QUALITY REASSESSMENT

Lowell High School
"1980 Building"
50 Father Morissette Boulevard
Lowell, MA



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
December 2019

Background

Building:	Lowell High School (LHS) “1980s” building
Address:	50 Father Morissette Boulevard, Lowell, MA
Assessment Coordinated Through:	Lowell Public Schools
Reason for Request:	Reassessment based on actions taken since the previous visit in 2017.
Date of Assessment:	October 25, 2019
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Jason Dustin, Environmental Analyst’ Cory Holmes, Environmental Analyst, Ruth Alfasso, Environmental Engineer, and Mike Feeney Director, Indoor Air Quality Program (IAQ)
Building Description:	The building at 50 Father Morissette Boulevard is a brick and concrete complex constructed in 1980. It has an attached fieldhouse containing gymnasiums, locker rooms, and a pool, which is now closed. This building is connected to the building at 14 French Street by several enclosed walkways.
Windows:	Openable

This school was visited previously in 2017. Two visits were made: one during the summer when the school was unoccupied and again in the fall during normal occupancy. Recommendations were made in a report following each visit. The MDPH/IAQ Program returned to the school this year for a follow-up visit, in part to assess the response to recommendations made in our previous report as well as to provide further recommendations to improve IAQ. Appendix A shows recommendations from both 2017 reports. In addition, the LHS complex will be undergoing significant renovations over the next several years. Recommendations included in this report will also address planning for renovation-related issues.

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

Table 1 includes indoor air testing results, which are summarized below.

- ***Carbon dioxide levels*** were above the MDPH guideline of 800 parts per million (ppm) in about half of all areas assessed, indicating a lack of air exchange in those areas of the building. Appendix B is an additional resource about carbon dioxide.
- ***Temperature*** was within the recommended range of 70°F to 78°F in all areas the day of assessment.
- ***Relative humidity*** was within or close to the lower end of the recommended range of 40 to 60% in the areas tested.
- ***Carbon monoxide*** levels were non-detectable (ND) in the areas tested.
- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality (NAAQS) limit of 35 $\mu g/m^3$ in all areas tested.

Ventilation

A heating, ventilating, and air conditioning (HVAC) system has several functions. First it provides heating and, if equipped, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but by filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. Even if an HVAC system is operating as designed, point sources of respiratory irritation may exist and cause symptoms in sensitive individuals.

Fresh air is provided by multiple air-handling units (AHUs) located on the roof. The AHUs are mostly "packaged" units that provide both heat and air conditioning (AC). Fresh air intakes draw in fresh air through an intake vent where it is filtered, then heated or cooled. The conditioned fresh air is mixed with some air returned from classrooms, then supplied to rooms through supply diffusers/grates throughout the building (Picture 1). Return vents (Picture 2) bring stale air back to the AHUs where a portion of this air is exhausted through louvers. The HVAC systems should be regularly maintained and operate continuously during occupied hours.

Based on air sampling, many classrooms with normal occupancy appeared to have a lack of air exchange provided by the HVAC system in its current operating mode. Given the age and operation of the existing HVAC system, it may be necessary to use openable windows to supplement fresh air supply for classrooms. It may be possible to adjust AHUs to allow more fresh air into the system, e.g. by opening supply louvers or adjusting the proportion of air exhausted rather than recirculated. Exhaust ventilation should also be checked periodically to ensure a draw of air from classrooms. In addition, no air circulation was detected in the Nurse's suite from either the supply or return/exhaust vents. This area is entirely dependent on mechanical ventilation for it has no windows.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air while removing stale air from a room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). It is unknown the last time these systems were balanced.

Microbial/Moisture Concerns

Water-damaged ceiling tiles and plaster walls were observed in many classrooms, offices, and hallways (Picture 1, 3 and 4; Table 1), indicating leaks from the building envelope or plumbing system. The roof of the 1980s building has not undergone any significant repair/replacement since the previous IAQ visit in 2017, so roof leaks account for the majority of stained ceiling tiles. In addition, occupants report active leaks in some areas.

Ceiling tiles should be replaced after the leak is found and repaired. In general, ceiling tiles have an open space above them (the ceiling plenum) and tend to dry out quickly, reducing the chance for mold colonization. Ceiling plaster does not contain organic material; therefore, it will not support microbial growth even when frequently moistened. In some cases, dust or paint on the surface of plaster can become mold colonized. If this occurs, plaster can often be cleaned to remove the mold.

In many areas, ceiling tiles were also missing (Picture 5; Table 1). These need to be replaced to maintain a continuous ceiling plenum and prevent dust and debris from above the ceiling tiles entering occupied areas.

Carpeting is a material that can become water-damaged and colonized with mold. The BEH/IAQ Program does not recommend the use of carpeting in schools, particularly in ground floor or basement levels, due to the likelihood of it becoming moistened due to spills, tracked in moisture, and condensation. During the previous visits to LHS, musty odors were noted in many classrooms with carpeting, and carpeting in the building was mostly found to be beyond its service life and in poor condition. Much of the older carpeting has been removed from the building since the 2017 visit (Table 1).

Some old carpeting remains in the building including some that is visibly stained, wrinkled, or threadbare (Table 1), indicating it was past its service life. The service life of carpeting in schools is approximately 10-11 years (IICRC, 2002). Aging carpet can produce fibers that can be irritating to the respiratory system. In addition, tears or lifting carpet can create tripping hazards. Carpeting should be cleaned annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning, and Restoration Certification (IICRC, 2012).

Measures should be taken to ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008). The US EPA and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials (e.g., ceiling tiles, gypsum wallboard) be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008; ACGIH, 1989). If not dried within this time frame they should be removed/discarded.

Some areas in the buildings are equipped with AC from the AHUs. Doors between these areas and non-air-conditioned areas should be kept closed to prevent condensation of humid air on chilled surfaces. Windows should also not be opened in a room while AC is operating. This can lead to condensation on surfaces chilled by air conditioning which can moisten building materials.

Windows are openable in most exterior classrooms. Open windows can be an additional source of fresh air. However, windows need to be tightly closed at the end of each day to prevent water infiltration and pest intrusion. A window was found closed around ivy, which prevents a tight seal (Picture 6). In addition, ivy and other plants should be removed from in and adjacent to the exterior of the building as plants can hold water against the exterior and lead to building envelope deterioration. They can also be a source of pollen and odors through open windows.

Refrigerators and microwaves were found in some classrooms and offices (Table 1), which should be kept clean and free of spills and spoiled food (Picture 7). Refrigerators and water dispensers should not be placed in carpeted areas where spills or leaks could moisten carpeting.

There are sinks in some classrooms (and other areas; Table 1), some of which appear not to be used. There may also be unused floor drains. The trap seals in unused drains can dry out and allow sewer gas and odors into occupied areas. Seldom used drains should be wetted periodically to maintain the trap seal. Some science rooms had safety showers, which should be monitored and maintained to prevent leaks. No porous materials should be stored under or near the safety showers.

Other Conditions

Exposure to low levels of volatile organic compounds (VOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. BEH/IAQ staff examined spaces for products containing VOCs, noting cleaning products, air fresheners, hand sanitizers and dry erase materials in a number of areas throughout the space (Table 1). All of these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals. Other sources of total volatile organic compounds (TVOCs) include copy machines and laminators. Excess heat, odors, VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Laminators produce TVOCs and plastic odors. This equipment should be used in well-ventilated areas away from occupants.

Some occupants reported problems with mice in occupied areas. Mouse urine is a known sensitizer/allergen having irritant effects upon some occupants.

In many areas, items, including books, papers, and decorative items were observed on floors, windowsills, tabletops, counters, bookcases, and desks, which can make it more difficult for custodial staff to clean (Table 1). Many classrooms had personal fans and some of these had dusty blades. Many supply and exhaust vents were also observed to be dusty (Picture 2; Table 1). Dust on ventilation and fan equipment can be aerosolized when the units are activated.

Conclusions/Recommendations

The following recommendations are made to assist in improving IAQ:

1. Consult A for previous recommendations that need additional work.

2. Operate supply and exhaust ventilation continuously during occupied hours. Adjust ventilation equipment (e.g. louvers, flow rates) where possible to increase fresh air, particularly to frequently used classrooms.
3. Do not block supply or exhaust vents with furniture or items. Check exhaust/return vents periodically for proper function. Where exhaust vents are switch-operated, ensure they are turned on when the room is occupied.
4. Ensure mechanical ventilation to the Nurse's suite is functional/operating; make repairs as needed.
5. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
6. Ensure areas which generate pollutants, such as cooking class areas, have operable exhaust functioning.
7. Ensure that a system of regular "Operations and Maintenance" remains in place to keep HVAC systems in proper working order.
8. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
9. Replace remaining water-damaged ceiling tiles and monitor for new leaks (e.g., room 617). Prioritize replacement of ceiling tiles with potential mold staining and in frequently-occupied areas.
10. Remove remaining water-damaged, musty, or worn carpeting. Replace with non-porous materials if possible.
11. Repair water-damaged plaster.
12. Repair/replace any other water-damaged/mold-colonized porous building materials (e.g., gypsum wallboard) in classrooms, hallways and stairwell areas.
13. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
14. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
15. Regularly inspect window and portable air conditioning units to ensure proper drainage of condensate and regular cleaning of filters.

16. Ensure that doors are closed between areas with air conditioning and areas without air conditioning, to avoid condensation of humid air on chilled surfaces.
17. Refrain from storing porous items (e.g., boxes, books, paper, clothing) directly on flooring, in below grade spaces, under sink cabinets and near safety showers to avoid microbial colonization.
18. Ensure unused or seldom used drains are wetted periodically to maintain the trap seal.
19. Avoid placing refrigerators and water dispensers on carpet.
20. Clean refrigerators frequently to prevent spills and odors.
21. Trim back trees/vegetation within 5′ of the building. Remove vegetation (e.g., ivy) that is growing on the building to avoid damage to exterior from associated moisture.
22. Reduce the use of products containing fragrances and VOCs.
23. Locate photocopiers and laminators in well ventilated areas away from occupants.
24. Ensure Material Safety Sheets are available for all laboratory, maintenance and janitorial chemicals used in the building.
25. Contract with a pest control company to regularly inspect and control mice in occupied areas. Keep food in secure containers and seal any pathways that may allow rodent entry to the building. Thoroughly clean areas where mice have been observed to remove mouse dander and urine which are common allergens.
26. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter.
27. Consider reducing the amount of items stored in classrooms to make cleaning easier. Periodically move items to clean flat surfaces.
28. Clean any remaining carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
29. Encourage faculty to report classroom/building related issues via a tracking program.
30. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is

recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

31. As construction on this building is planned and commences, use the guidance "Methods Used to Reduce/Prevent Exposure to Construction/Renovation Generated Pollutants in Occupied Buildings" which is included as Appendix C.

32. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.

33. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

IICRC. 2002. Institute of Inspection, Cleaning and Restoration Certification. A Life-Cycle Cost Analysis for Floor Coverings in School Facilities.

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. Carpet Cleaning: FAQ.

MDPH. 2015. Massachusetts Department of Public Health. "Indoor Air Quality Manual: Chapters I-III". Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2000. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/index.html.

US EPA. 2008. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. September 2008. Available at: http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide.

Picture 1

Supply vent (arrow) and water-damaged ceiling tiles

Picture 2

Return/exhaust vent, note dust on vent

Picture 3

Water-damaged ceiling tiles

Picture 4

Water-damaged ceiling tiles

Picture 5

Missing ceiling tiles

Picture 6

Ivy coming in window

Picture 7

Microwave with food spill

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Background (outside)	422	ND	59	52	12	-	-	-	-	
Third Floor										
Mr. O'Keefe	1000	ND	74	44	14	1	N	Y	Y	DEM, NC
Hosmer office	906	ND	76	41	11	1	N	Y	Y	NC
Quinton office	943	ND	74	41	11	1	N	Y	Y	NC, fridge
Consultant's office	852	ND	74	40	12	0	N	Y	Y	NC
Plant room	760	ND	76	38	12	1	N	N	Y	PC, WD CT, floor drain, sink (currently used as an office)
Hallway next to plant room	-	-	-	-	-	-	-	-	-	WD CTs, MTs
610A	957	ND	74	39	12	1	N	Y	Y	HS, WD, DEM, computers

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
610B	746	ND	73	39	11	1	N	Y	Y	Carpet, DEM
612	1810	ND	74	48	14	25	N	Y	Y	HS, WD
613	1328	ND	74	44	14	30 gone 20 minute	N	Y	Y	Active WD CTs
614	1107	ND	73	44	12	26	N	Y	Y	DEM, HS
615	1027	ND	73	44	12	1	N	Y	Y	WD CTs, DEM
616	941	ND	72	42	12	25	N	Y	Y	MT, WD CT
617	1126	ND	73	43	7	15	Y	Y	Y	NC, WD CT and MT, reports of leaks “raining inside”, DEM
619	1227	ND	73	47	10	26	N	Y	Y	
620	1232	ND	75	42	10	0	N	Y	Y	NC, DEM, PF

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
622C	770	ND	75	39	9	11	N	Y	Y	4 MT, WD CT, dusty vents and adjacent CT, DEM, NC
623	1223	ND	75	41	9	30	N	Y	Y	NC, DEM, 4 WD CT
624	1028	ND	75	39	8	0	N	Y	Y	DEM, loud vent, dusty vents and dusty CT
624 science lab	1088	ND	75	40	8	0	N	Y	Y	Science sinks, one drips, AI, fridge and microwave
625	978	ND	74	39	8	1	N	Y	Y	DEM, CP
625 science lab	1008	ND	75	39	9	16	N	Y	Y	Science class in progress, DEM, dusty vents, auxiliary exhaust in lab – on
625 Science prep room									Y	Chemical storage in cabinets and shelves
626	849	ND	74	38	8	25	N	Y	Y	4 WD CT
626 lab	808	ND	74	37	7	3	N	Y	Y	Sink, dusty vents, CP, WD CT

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
628 computers	899	ND	73	37	7	0	N	Y	Y	Many WD CT, NC, computers
629 computers	772	ND	73	37	7	30	N	Y	Y	NC, DEM, computers
630	714	ND	75	37	9	0	N	Y	Y	NC, DEM, PF – dusty
640	967	ND	73	42	11	1	N	Y	Y	PF on
642	853	ND	74	40	10	0	N	Y	Y	AF odor (plug-in), NC, DEM
643	1015	ND	74	43	9	25	N	Y	Y	NC, DEM, dusty vents
644	907	ND	73	40	8	1	N	Y	Y	NC, DEM, HS
645	1187	ND	74	46	8	25	N	Y	Y	NC, dusty vents, DEM
646 A	832	ND	73	40	7	11	N	Y	Y	NC, WD CT, dusty vents

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
652	607	ND	71	40	8	1	Y 1 open	Y	Y	NC, DEM, dusty vents, WD CT
653	838	ND	71	42	6	16	Y	Y	Y	DEM, NC
654	754	ND	71	43	10	2	N	Y	Y	DEM, HS
655	868	ND	72	42	7	25	Y	Y	Y	DEM, chalk, NC
656	947	ND	72	44	11	28	N	Y	Y	DEM
657	790	ND	72	41	8	18	Y 3 open	Y	Y	NC, DEM, chalk
658	830	ND	72	43	9	1	N	Y	Y	DEM, WD CT
Second Floor										
Little Theater	499	ND	72	37	7	0	N	Y	Y	Carpet

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Library	553	ND	71	41	11	4	N	Y	Y	Old carpet, WD CTs and ceiling, reported allergy triggers
512	775	ND	72	44	8	7	N	Y	Y	HS, WD CT, WD GW
514	884	ND	73	43	8	11	N	Y	Y	
515	-	-	-	-	-	-	-	-	-	Locked
516	788	ND	72	42	10	9	N	Y	Y	
517	724	ND	72	42	9	1	Y	Y	Y	HS
518	693	ND	72	42	8	0	Y	Y	Y	MTs, HS, WD CT
522	653	ND	73	39	7	14	N	Y	Y	Computers, NC, DEM
523	764	ND	73	40	7	16	N	Y	Y	NC, DEM, dusty vents

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
526	814	ND	72	41	8	23	N	Y	Y	DEM, NC
527	1021	ND	74	42	9	12	N	Y	Y	NC, DEM
533	626	ND	73	38	9	0	N	Y	Y	DEM, 1 WD CT
535	727	ND	74	40	8	30	N	Y	Y	PF – on, NC, 5 WD CT, food odors
537	790	ND	72	40	10	4	N	Y	Y	NC, 1 WD CT
542	688	ND	74	36	8	18	N	Y	Y	NC, DEM, computers
543	828	ND	74	37	13	30	N	Y	Y	DEM, NC
545	1075	ND	74	41	8	25	N	Y	Y	NC
546	842	ND	74	40	8	1	N	Y	Y	DEM, WD CT and MT (3)

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
547	1022	ND	73	43	9	14	N	Y	Y	NC, chalk, DEM
552	505	ND	72	39	12	7	Y	Y	Y	WD CTs
553	607	ND	74	38	12	1	Y	Y	Y	DEM
554	735	ND	73	42	10	16	Y	Y	Y	DEM
555	661	ND	73	40	11	1	Y	Y	Y	DEM
556	958	ND	73	44	13	21	Y	Y	Y	MT
557	757	ND	73	41	12	0	Y	Y	Y	DEM
558	867	ND	73	44	11	27	Y	Y	Y	HS
First Floor										

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lowell High School 1980 building **Indoor Air Results**

Address: 50 Father Morisette Blvd, Lowell **Table 1 (continued)** **Date: 10/25/2019**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Small Cafeteria	569	ND	72	41	8	~40	N	Y	Y	
Cafeteria	644	ND	72	40	7	~200	Y	Y	Y	Dust/debris on vents/CTs
Athletic Director Office	810	ND	73	43	8	1	N	Y	N	PC
Nurse's Suite	589	ND	74	46	9	3	Y	Y	Y	No airflow detected from vents
Wrestling Room	794	ND	72	43	6	28	N	Y	Y	MTs
Weight Room	733	ND	72	42	8	30	N	Y	Y	Dust/debris on vents, MTs
Girls Locker Room	545	ND	72	40	7	0	N	Y	Y	Dust/debris on vents, MTs, broken floor tiles
Girls Varsity Locker Room	528	ND	71	40	7	0	N	Y	Y	Dust/debris on vents, WD CTs
Cardio Room	589	ND	70	42	7	~25	N	Y	Y	MTs

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Boys Locker Room	525	ND	72	42	9	0	N	Y	Y	Dust/debris on vents
Boys Varsity Locker Room	527	ND	71	40	6	4	N	Y	Y	Dust/debris on vents, MTs
412	612	ND	73	38	7	3	Y	Y	Y	Carpet
437	667	ND	74	38	5	0	N	Y	Y	Carpet
452C	796	ND	73	40	7	2	N	N	Y	Dust/debris on vents, door open
Field House										
Gym	672	ND	71	43	5	200+	N	Y	Y	Rubberized flooring

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
AI = accumulated items
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
GW = gypsum wallboard
HS = hand sanitizer
MT = missing CT
NC = not carpeted
PC = photocopier
PF = personal fan
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

APPENDIX A

Previous Recommendations

Conclusions/Recommendations from the visit made in July of 2017

The following recommendations are made to assist in improving IAQ:

1. Replace any water-damaged or mold-colonized porous building materials (e.g., ceiling tiles, gypsum wallboard, carpeting) in classrooms, hallways, and stairwell areas. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
2. Consult with a roofing contractor to assess the roofing system. Repairs should be made to stop leaks and chronic water damage to building materials. The roofing system should then be monitored regularly for water pooling, leaks, and other deteriorating conditions.
3. Consult with an HVAC contractor to thoroughly examine all HVAC system components to ensure proper function. Make any necessary repairs to ensure the system is working as designed.
4. Ensure that a system of regular "Operations and Maintenance" remains in place to keep HVAC systems in proper working order.
5. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
6. Operate all supply and exhaust ventilation equipment continuously during occupied periods. Do not block supply or exhaust vents with furniture or items.
7. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
8. Ensure chemical treatment of the pool is controlled to minimize pool odors. Ensure the exhaust system in the pool area is operating at all times and properly adjusted to effectively remove odors and moisture. In addition, ensure that doors between the pool and other occupied areas are weather-tight to prevent migration of odors and moisture.
9. Ensure any plumbing leaks are repaired to avoid chronic water damage in the building.
10. Ensure that condensation from AHU equipment is draining properly. Check collector pans, piping and any associated pumps for clogs and leaks and clean periodically to

prevent stagnant water build-up and remove debris that may provide a medium for microbial growth.

11. Ensure that doors are closed between areas with air conditioning and areas without air conditioning to avoid condensation of humid air on chilled surfaces.
12. Replace water-damaged and mold-colonized ceiling tiles after leaks have been addressed. Clean/remediate any moldy wall material consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
13. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
14. Consider utilizing MERV 8 filters in AHUs. Check with manufacturer's recommendations before changing filter efficiency. Continue to change filters 2-4 times a year.
15. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter.
16. Clean carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
17. Replace/repair fluorescent light covers; ensure fluorescent lights are fully secured to prevent breakage and clean debris out of covers.
18. Encourage faculty to report classroom/building related issues via a tracking program.
19. Continue to adopt the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
20. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Conclusions/Recommendations from the visit made in December of 2017

The following recommendations are for improving indoor air and environmental quality:

1. Consult with an HVAC contractor to thoroughly examine all HVAC system components to ensure proper function. Make any necessary repairs to ensure the system is working as

designed. Assess whether adjustments can be made to allow more fresh air into the system.

2. Operate all supply and exhaust ventilation equipment continuously during occupied periods. Do not block supply or exhaust vents with furniture or items. Check exhaust/return vents periodically for proper function.
3. Consider changing the style of fresh air vents or relocating them to prevent drafts (e.g., Hosmer office; Table 2).
4. Ensure that a system of regular “Operations and Maintenance” remains in place to keep HVAC systems in proper working order.
5. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
6. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day. Inform occupants that windows should not be opened while the HVAC system is in cooling mode to avoid condensation.
7. Replace any water-damaged or mold-colonized porous building materials (e.g., ceiling tiles, gypsum wallboard, carpeting) in the library, classrooms, hallways, and stairwell areas. Ensure water-damaged materials are cleaned, replaced, and/or repaired in a manner consistent with the U.S. Environmental Protection Agency’s guidelines (US EPA, 2008).
8. Consult with a roofing contractor to assess the roofing system. Repairs should be made to stop leaks and chronic water damage to building materials. The roofing system should then be monitored regularly for water pooling, leaks, and other deteriorating conditions.
9. Consider removal of wall-to-wall carpeting in classrooms and other areas where spills, leaks or wear are a concern. Replace with non-porous flooring.
10. Avoid locating refrigerators and water dispensers in carpeted areas. Place on non-porous flooring or use a waterproof mat to protect the carpet.
11. Seal gaps in sink backsplashes with an appropriate waterproof sealant. Do not store porous items underneath or adjacent to sinks and safety showers/eyewashes.
12. Ensure doors seal tightly between air conditioned and non-air-conditioned areas and that these doors are closed when air conditioning is in use.
13. Ensure chemical treatment of the pool is controlled to minimize pool odors. Ensure the exhaust system in the pool area is operating at all times and properly adjusted to

effectively remove odors and moisture. In addition, ensure that doors between the pool and other occupied areas are weather-tight to prevent migration of odors and moisture.

14. Ensure any plumbing leaks are repaired to avoid chronic water damage in the building.
15. Ensure that condensation from AHU equipment is draining properly. Check collector pans, piping and any associated pumps for clogs and leaks and clean periodically to prevent stagnant water build-up and remove debris that may provide a medium for microbial growth.
16. Replace water-damaged and mold-colonized ceiling tiles after leaks have been addressed. Clean/remediate any moldy wall materials consistent with the U.S. Environmental Protection Agency's guidelines (US EPA, 2008).
17. Replace any missing or ajar ceiling tiles to avoid pathways to unconditioned areas.
18. Reduce the use of products containing VOCs.
19. Locate photocopiers and laminators in well ventilated areas away from occupants.
20. Store laboratory chemicals in an organized manner consistent with the guidance in Appendix A ("Guidance Concerning Proper Use and Storage of Chemicals in Schools to Protect Public Health").
21. Ensure Material Safety Sheets are available for all laboratory, maintenance and janitorial chemicals used in the building.
22. Consider utilizing MERV 8 filters in AHUs. Check with manufacturer's recommendations before changing filter efficiency. Continue to change filters 2-4 times a year.
23. Regularly clean supply/return vents and fans to avoid aerosolizing accumulated particulate matter. If soiled ceiling tiles around vents cannot be cleaned, replace.
24. Consider reducing the amount of items stored in classrooms to make cleaning easier. Periodically move items to clean flat surfaces.
25. Clean carpeting and area rugs annually or more often in high-traffic locations in accordance with IICRC recommendations (IICRC, 2012) and discard those that are worn out or too soiled to be cleaned.
26. Affix the electrical outlet in medical office to wall. Identify the purpose of the wires in the medical office and cap/remove as needed.
27. Encourage faculty to report classroom/building related issues via a tracking program.

28. The school should be tested for radon by a certified radon measurement specialist during the heating season when school is in session. Radon measurement specialists and other information can be found at: www.nrsb.org, and http://aarst-nrpp.com/wp.
29. Continue to adopt the US EPA (2000) document, “Tools for Schools”, as an instrument for maintaining a good IAQ environment in the building available at: http://www.epa.gov/iaq/schools/index.html.
30. Refer to resource manual and other related IAQ documents located on the MDPH’s website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

Appendix B

Carbon Dioxide and its Use in Evaluating Adequacy of Ventilation in Buildings

The Bureau of Environmental Health's (BEH) Indoor Air Quality (IAQ) Program examines indoor air quality conditions that may have an effect on building occupants. The status of the ventilation system, potential moisture problems/microbial growth and identification of respiratory irritants are examined in detail, which are described in the attached report. In order to examine the function of the ventilation system, measurements for carbon dioxide, temperature and relative humidity are taken. Carbon dioxide measurements are commonly used to assess the adequacy of ventilation within an indoor environment.

Carbon dioxide is an odorless, colorless gas. It is found naturally in the environment and is produced in the respiration process of living beings. Another source of carbon dioxide is the burning of fossil fuels. Carbon dioxide concentration in the atmosphere is approximately 250-600 ppm (Beard, 1982; NIOSH, 1987).

Carbon dioxide measurements within an occupied building are a standard method used to gauge the adequacy of ventilation systems. Carbon dioxide is used in this process for a number of reasons. Any occupied building will have normally occurring environmental pollutants in its interior. Human beings produce waste heat, moisture and carbon dioxide as by-products of the respiration process. Equipment, plants, cleaning products or supplies normally found in any building can produce gases, vapors, fumes or dusts when in use. If a building has an adequately operating mechanical ventilation system, these normally occurring environmental pollutants will be diluted and removed from the interior of the building. The introduction of fresh air both increases the comfort of the occupants and serves to dilute normally occurring environmental pollutants.

An operating exhaust ventilation system physically removes air from a room and thereby removes environmental pollutants. The operation of supply in conjunction with the exhaust ventilation system creates airflow through a room, which increases the comfort of the occupants. If all or part of the ventilation system becomes non-functional, a build up of normally occurring environmental pollutants may occur, resulting in an increase in the discomfort of occupants.

The MDPH approach to resolving indoor air quality problems in schools and public buildings is generally two-fold: 1) improving ventilation to dilute and remove environmental pollutants and 2) reducing or eliminating exposure opportunities from materials that may be adversely affecting indoor air quality. In the case of an odor complaint of unknown origin, it is common for BEH staff to receive several descriptions from building occupants. A description of odor is subjective, based on the individual's life experiences and perception. Rather than test for a potential series of thousands of chemicals to identify the unknown material, carbon dioxide is used to judge the adequacy of airflow as it both dilutes and removes indoor air environmental pollutants.

As previously mentioned, carbon dioxide is used as a diagnostic tool to evaluate air exchange by building ventilation systems. The presence of increased levels of carbon dioxide in indoor air of buildings is attributed to occupancy. As individuals breathe, carbon dioxide is exhaled. The greater the number of occupants, the greater the amount of carbon dioxide produced. Carbon dioxide concentration build up in indoor environments is attributed to inefficient or non-functioning ventilation systems. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

Carbon dioxide can be a hazard within enclosed areas with **no air supply**. These types of enclosed areas are known as confined spaces. Manholes, mines and sewer systems are examples of confined spaces. An ordinary building is not considered a confined space. Carbon dioxide air exposure limits for employees and the general public have been established by a number of governmental health and industrial safety groups. Each of these standards of air concentrations is expressed in parts per million (ppm). *Table 1* is a listing of carbon dioxide air concentrations and related health effects and standards.

The MDPH uses a guideline of 800 ppm for publicly occupied buildings (Burge et al., 1990; Gold, 1992; Norback, 1990; OSHA, 1994; Redlich, 1997; Rosenstock, 1996; SMACNA, 1998). A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Several sources indicate that indoor air problems *are significantly reduced* at 600 ppm or less of carbon dioxide (ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH, 1987). Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Air levels for carbon dioxide that indicate that indoor air quality may be a problem have been established by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). Above 1,000 ppm of carbon dioxide, ASHRAE recommends adjustment of the building’s ventilation system (ASHRAE, 1989). In 2001, ASHRAE modified their standard to indicate that no more than 700 ppm above the outdoor air concentration; however 800 ppm is the level where further investigation will occur.

Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). The main effect of carbon dioxide involves its ability to displace

oxygen for the air in a confined space. As oxygen is inhaled, carbon dioxide levels build up in the confined space, with a decrease in oxygen content in the available air. This displacement of oxygen makes carbon dioxide a simple asphyxiant. At carbon dioxide levels of 30,000 ppm, severe headaches, diffuse sweating, and labored breathing have been reported. No **chronic** health effects are reported at air levels below 5,000 ppm.

Air testing is one method used to determine whether carbon dioxide levels exceed the comfort levels recommended. If carbon dioxide levels are over 800-1,000 ppm, the MDPH recommends adjustment of the building's ventilation system. The MDPH recommends that corrective measures be taken at levels above 800 ppm of carbon dioxide in office buildings or schools. (Please note that carbon dioxide levels measured below 800 ppm may not decrease indoor air quality complaints). Sources of environmental pollutants indoors can often induce symptoms in exposed individuals regardless of the adequacy of the ventilation system. As an example, an idling bus outside a building may have minimal effect on carbon dioxide levels, but can be a source of carbon monoxide, particulates and odors via the ventilation system.

Therefore, the MDPH strategy of adequate ventilation coupled with pollutant source reduction/removal serves to improve indoor air quality in a building. Please note that each table included in the IAQ assessment lists BEH comfort levels for carbon dioxide levels at the bottom (i.e. carbon dioxide levels between 600 ppm to 800 ppm are acceptable and <600 ppm is preferable). While carbon dioxide levels are important, focusing on these air measurements in isolation to all other recommendations is a misinterpretation of the recommendations made in these assessments.

Table 1: Carbon Dioxide Air Level Standards

Carbon Dioxide Level	Health Effects	Standards or Use of Concentration	Reference
250-600 ppm	None	Concentrations in ambient air	Beard, R.R., 1982 NIOSH, 1987
600 ppm	None	Few indoor air complaints, used as reference for air exchange for protection of children	ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH 1987
800 ppm	None	Used as an indicator of ventilation adequacy in schools and public buildings, used as reference for air exchange for protection of children	Mendler, 2003 Bell, A. A., 2000; NCOSP, 1998; SMACNA, 1998; EA, 1997; Redlich, 1997; Rosenstock, 1996; OSHA, 1994; Gold, 1992; Burge et al., 1990; Norback, 1990 ; IDPH, Unknown
1000 ppm	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1989
950-1300 ppm*	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1999
700 ppm (over background)	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 2001
5000 ppm	No acute (short term) or chronic (long-term) health effects	Permissible Exposure Limit/Threshold Limit Value	ACGIH, 1999 OSHA, 1997
30,000 ppm	Severe headaches, diffuse sweating, and labored breathing	Short-term Exposure Limit	ACGIH, 1999 ACGIH. 1986

* outdoor carbon dioxide measurement +700 ppm

References

ACGIH. 1986. Documentation of the Threshold Limit Values. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1998. Industrial Ventilation A Manual of Recommended Practice. 23rd Edition. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

ACGIH. 1999. Guide to Occupational Exposures-1999. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989.

ASHRAE. 1999. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1999.

ASHRAE. 2001. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-2001.

Beard, R.R. 1982. Chapter Fifty-two, Inorganic Compounds of Oxygen, Nitrogen, and Carbon. *Patty's Industrial Hygiene and Toxicology, Vol. IIc*. *3rd ed.* Clayton, G. D. & Clayton, F. E., eds. John Wiley & Sons, New York, NY.

Bright, P.; Mader, M.; Carpenter, D.; and Hermon-Cruz, I.Z. 1992. Guideline for Indoor Air Surveys. Brooks Air Force Base, TX. Armstrong Laboratory, Occupational and Environmental Health Directorate. NTIS AL-TR-1992-0016.

Burge, H. and Hoyer, M. 1990. Focus On … Indoor Air Quality. Appl. Occup. Environ. Hyg. 5(2):88.

EA. 1997. Indoor Air Quality. Environment Australia, Department of the Environment, Sport and Territories, Canberra, Australia.
www.environment.gov.au/soe/1996/publications/technical/pubs/12indora.pdf

Gold, D. 1992. Indoor Air Pollution. Clinics in Chest Medicine. 13(2):224-225.

Hill, B.; Craft, B.; and Burkart, J. 1992. Carbon Dioxide, Particulates and Subjective Human Responses in Office Buildings without Histories of Indoor Air Quality Problems. Appl. Occup. Environ. Hyg. 7(2): 101-111.

IDPH. Unknown. Illinois Department of Public Health Guidelines for Indoor Air Quality. Illinois Department of Public Health, Springfield, Il.
http://www.idph.state.il.us/envhealth/factsheets/indoorairqualityguide_fs.htm

Mendler, S. and Odell, W. 2003. Indoor Air Quality for the EPA. *ArchitectureWeek.* April 16, 2003. http://www.architectureweek.com/2003/0416/environment_1-2.html

NCOSP. 1998. Workplace Requirements for Safety & Health, Indoor Air Quality 3.3.3. NC Office of State Personnel, Raleigh, NC. www.osp.**state**.nc.us/emprsk/safety/handbook/5-9.pdf

NIOSH. 1987. Guidance for Indoor Air Quality Investigations. Cincinnati, OH. National Institute for Occupational Safety and Health, Hazards Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluation and Field Studies.

Norback, D.; Torgen, M.; and Edling, C. 1990. Volatile Organic Compounds, Respirable Dust, and Personal Factors Related to Prevalence and Incidence of Sick Building Syndrome in Primary Schools. British Journal of Industrial Medicine. 47:740.

OSHA. 1994. Occupational Safety and Health Administration. Indoor Air Quality (Proposed Regulation), Federal Register 59:15968-16039, (1994) Appendix A.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Redlich, C.; Sparer, J.; and Cullen, M. 1997. Sick-building Syndrome. Lancet. 349:1016.

Rosenstock, L. 1996. NIOSH Testimony to the U.S. Department of Labor on Air Quality, Appl. Occup. Environ. Hyg. 11(12):1368.

SMACNA. 1998. Indoor Air Quality: A Systems Approach. 3rd ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc, Chantilly, VA. National Association, Inc.

Appendix C

Commonwealth of Massachusetts
Department of Public Health
Helping People Lead Healthy Lives In Healthy Communities

BUREAU OF ENVIRONMENTAL HEALTH

Indoor Air Quality Program

Methods Used to Reduce/Prevent Exposure to Construction/Renovation Generated Pollutants in Occupied Buildings

November 2006

Among the most serious indoor air quality health issues is the potential exposure to construction/renovation-generated pollutants in occupied buildings. The renovation of occupied buildings provides a number of potential exposure opportunities to pollutants. Demolition of the building materials can provide exposure to mold, asbestos, lead, bird waste and other respiratory irritants. The application of tile adhesive, roofing materials, paints and other products used during renovations provide point sources of volatile organic compounds (VOCs) and other irritating chemicals. Contractors frequently use fossil fueled construction and heating equipment in indoor areas undergoing renovations. Combustion products (e.g. carbon monoxide) can migrate into occupied areas. The impact of construction/renovation pollutants on occupied areas can be evaluated through air monitoring for VOCs, airborne particles and products of combustion. Preventing and/or minimizing exposure to construction/renovation-generated pollutants is essential to reduce indoor air-related symptoms in building occupants.

In 1999, the State Department of Education (DOE) amended their regulations to require that state funded construction projects follow established guidelines to prevent exposure of building occupants to construction/renovation pollutants. Subsequently, Chapter 208 of the Acts of 2004 transferred responsibility for the School Building Assistance Program from the DOE to the Massachusetts School Building Authority (MSBA). On September 6, 2006, the MSBA enacted regulations that require that schools receiving funds under the program for construction or renovation projects must confer with the most current edition of the "IAQ Guidelines for Occupied Buildings Under Construction" published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 963 CMR 2.04(2)(c),(d).

The MDPH has prepared this guidance in order to prevent/reduce the migration of renovation-generated pollutants into occupied areas and their potential impact on indoor air quality. The MDPH suggests that the following steps be taken on any renovation project within a public building.

Physical Isolation of Occupied Areas from Renovation Areas

Renovations of buildings should be separated from occupied areas by constructing temporary physical barriers. These barriers are typically constructed of plywood and polyethylene plastic built in or over passageways between the construction area and the occupied spaces. Construction barriers should be sealed with polyethylene plastic and duct tape on the construction side as well as the occupied side to provide a duel barrier. Inspection of these barriers should be conducted daily prior to commencement of construction activities to ensure integrity. A log of the location and condition of each barrier should be maintained in a log book.

Other migratory pathways for pollutants to move between construction and occupied areas should be examined and sealed. These migratory pathways may include but are not limited to:

- Crawlspaces
- Electrical outlets and light switches in shared walls
- Pipe and electrical conduits between walls
- Ventilation system ductwork
- Holes in interior walls and/or spaces above interior walls and roof/floor decking (e.g., spaces above ceiling tile systems).

Outdoor construction-generated pollutants can migrate indoors under various conditions. The following are recommendations to reduce migration of *outdoor* pollutants to the indoor environment:

- Seal around exterior doors with weather stripping and door sweeps to prevent infiltration of outdoor construction-generated pollutants.
- Cover with tarps any dirt/debris piles in close proximity to the building or wet down dirt/debris to decrease aerosolization of particulates, when possible.
- Change HVAC filters more regularly in areas impacted by renovation activities. Upgrading to more efficient filters for these units should also be considered.
- Temporarily deactivate the HVAC system during construction generating high amounts of outdoor pollutants. If activity is longer than one day, alternative means of ventilation should be provided for the impacted areas. If not feasible, relocation of activities in these areas should be considered.

The Use of Pressurization/Depressurization Techniques

Construction sites should be isolated and depressurized compared with occupied areas to control for renovation pollutants. To achieve depressurization, use fans to draw air away from occupied areas. Use of the existing supply ventilation system to introduce fresh outside air into occupied space should be used to increase air pressure in occupied areas adjacent to construction activities. In order to assess whether depressurization has occurred, air pressure monitoring (using a micromanometer) to measure air pressure differential between occupied space and construction areas should be used. Monitoring should be done daily at each barrier to ensure appropriate pressurization. Results of the location, dates and results of air pressure monitoring should be kept in a log book. No construction work should occur in areas immediately adjacent to occupied areas if:

- Depressurization is not achieved,
- Air pressure monitoring has not been done that day, or
- Odor/construction related complaints have been made by occupants in adjacent areas.

Operation of the Existing Ventilation Systems

Precautions should be taken to avoid the *re-entrainment* of construction-related materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities and contingency plans to maintain adequate supply of fresh air and temperature must also be developed and implemented to maintain building occupant safety and comfort. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and using filters with a higher dust spot efficiency where needed.

Administrative Management to Prevent Exposure to Construction Generated Pollutants

Various administrative actions can also prevent occupant exposures to construction/renovation-generated pollutants. The following measures should be used to prevent, eliminate or reduce occupant exposure to construction-generated pollutants:

- Schedule projects that produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.
- Develop a notification system for building occupants to report construction/renovation related odors and/or dust problems to the building administrator. These concerns should be relayed to the contractor in a manner to allow for a timely remediation of the problem.
- Disseminate scheduling itinerary to all affected parties; this can be done in the form of meetings, newsletters or weekly bulletins.
- Notify occupants about construction activities that may be conducted in close proximity to their work areas. In certain cases, HVAC equipment for areas adjacent to construction activities may need to be deactivated and windows closed periodically to prevent unfiltered air and vehicle exhaust from entering the building. For this reason, prior notification(s) should be made.
- If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from areas of renovations.
- Keep Material Safety Data Sheets (MSDS) for all construction materials used during renovations in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act.

Appendix C

Control/Reduction of Pollutants in Occupied Areas

Frequently, renovations include the replacement of components of the HVAC system, rendering windows as the only source of fresh air. In this environment, removal of normally occurring pollutants as well as construction-generated pollutants must be enhanced to reduce exposure.

The following recommendations are made to reduce exposure under these circumstances:

- Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. This should include daily cleaning of occupied areas during the course of renovation work generating dust, fumes and other particulate materials.
- Consider increasing the number of personnel or work hours for existing staff (e.g., before school) to provide increased cleaning of dirt/dust accumulation in occupied areas due to construction/renovation activities.
- Control for dusts by using a high efficiency particulate air filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping/mopping of all surfaces.
- Cover with tarps any dirt/debris piles (indoors and outdoors) in close proximity to the building or wet down dirt/debris (outdoors) to decrease aerosolization of particulates, when possible.
- Change HVAC filters more regularly in areas impacted by renovation activities. Upgrading to more efficient filters for these units should also be considered.

Inspection upon Request

The Massachusetts Department of Public Health, Bureau of Environmental Health, Indoor Air Quality Program, is available to inspect a public building upon receipt of a written request for inspection from and in cooperation with the appropriate government agency.

QUESTIONS

If you have any questions concerning these guidelines, please contact:

Massachusetts Department of Public Health
Bureau of Environmental Health, Indoor Air Quality Program
250 Washington Street, 7th Floor
Boston, MA 02108
Phone: (617) 624-5757 Fax: (617) 624-5777

Document Reviewed: August 2008

City of Lowell Department of Public Works
1365 Middlesex Street • Lowell, MA 01852
P: 978.674.4111 • F: 978.970.4071
www.LowellMA.gov

Christine Clancy, P.E., *DPW Commissioner*

HANDOUT
BOH 2.5.2020

TO: Eileen Donoghue, City Manager

FROM: Christine Clancy, P.E., DPW Commissioner

DATE: February 5, 2020

RE: BOH Update: Indoor Air Quality Assessment LHS and Freshman Academy

---

The City has received indoor air quality assessment reports dated December 2019 of the Lowell High School 1922 and 1980 buildings. These indoor air quality assessments were conducted as a follow up to an assessment completed in 2017. The City has received the Freshman Academy Indoor Air Quality Report and is reviewing the report and the recommendations made within the report.

The completed indoor air testing included testing of carbon dioxide levels, temperature, relative humidity, carbon monoxide, and fine particulate matter (PM2.5). The air quality results showed improvements from the 2017 results yet still exceedances in the carbon dioxide levels. Carbon dioxide levels that exceed the MDPH guidelines of 800 parts per million (ppm) typically indicate lack of air exchange or ventilation. Given the age and condition of the LHS HVAC system and with the new high school construction in the horizon, it is understandable that ventilation issues exist; however, the City also recognizes and as recommended in the report, improvements can be made to certain areas of the school or specific rooms in an effort to further improve air quality.

The City DPW, Health Department, and School Department conducted a site visit of both the 1922 and 1980 buildings on January 9, 2020. As an outcome to the meeting, action items are summarized below. The City and School Department will work on these recommendations on the month of February, and particularly during February vacation, and provide another update to the Board of Health in March.

1. School Department will replace several old carpets that remain in the 1922 building during February vacation. Any other older carpets that remain will be steam cleaned beginning in February and continue through the rest of the school year.
2. General cleaning of other tile or wooden floors and dusting of rooms to be completed on February vacation and completed on a routine basis by the School Department.
3. City DPW and School Department to complete cleaning on all air intake/exchange vents in month of February and quarterly cleanings to be completed. Any abandoned ducts to be cleaned and sealed up in an airtight manner by the DPW where feasible.
4. Report recommends adjustment to the supply and exhaust ventilation where possible and rebalancing of the system where feasible. This is being evaluated by DPW to see where adjustments are feasible and cost effective given the age of the system and the proximity to the construction of the new LHS.

City of Lowell Department of Public Works
1365 Middlesex Street • Lowell, MA 01852
P: 978.674.4111 • F: 978.970.4071
www.LowellMA.gov

Christine Clancy, P.E., *DPW Commissioner*

5. Some rooms were found with furniture that blocked ventilation. Rooms were noted and adjustments will be made by School Department.
6. Report recommends use of openable windows to supplement fresh air during temperature windows. This currently is implemented; however, the City DPW and School Facilities Department will review this recommendation to see if a policy is required. Windows will have to be closed outside of occupied hours.
7. Recommendation made in cooking room located in basement of 1922 building to remove a gas stove or replace it with an electric stove.
8. The report recommends replacement of water damaged ceiling tiles and installation of missing ceiling tiles. A majority of the tiles have been replaced or installed and will continue to be replaced through the month of February.
9. The report recommends replacement of flooring in a closet in Room 105A. This closet has been limited access until repairs are made.
10. Any water damaged plaster or walls noted on site walk will be removed and replaced. These areas were limited throughout both buildings.
11. School Department to establish policies on use of portable AC units and refrigerators on carpeted areas.
12. Vines were noted growing on the building façade. DPW will cut the roots of these vines to limit growth.
13. The report noted rooms with dry erase or chalk materials or cleaning agents. School Department to establish a policy on storage of these materials in a closet or closed area.
14. School Department to discuss placement of printers, copiers, and laminators in the school and coordinate with DPW if can be located in a well ventilated area.

Cc: Kara Keefe Mullin, Assistant City Manager
JoAnn Keegan, Interim Director, Health and Human Services
Jim Green, Deputy Commissioner Lands & Buildings
Jim Hall, Rick Underwood; Lowell Schools

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Morbidity and Mortality Weekly Report (*MMWR*)

Bott 2-5-20

Notes from the Field: HIV Diagnoses Among Persons Who Inject Drugs — Northeastern Massachusetts, 2015–2018

Weekly / March 15, 2019 / 68(10);253–254

Kevin Cranston, MDiv[1]; Charles Alpren, MBChB[2,3]; Betsey John, MPH[1]; Erica Dawson, PhD[3,4]; Kathleen Roosevelt, MPH[1]; Amanda Burrage, MD[3,5]; Janice Bryant[1]; William M. Switzer, MPH[4]; Courtney Breen, MA[1]; Philip J. Peters, MD[4]; Tracy Stiles, MS[1]; Ashley Murray, MPH[4]; H. Dawn Fukuda, ScM[1]; William Adih, PhD[4]; Linda Goldman, MBA, MSW[1]; Nivedha Panneer, MPH[4]; Barry Callis, MSW[1]; Ellsworth M. Campbell, MSc[4]; Liisa Randall, PhD[1]; Anne Marie France, PhD[4]; R. Monina Klevens, DDS[1]; Sheryl Lyss, MD[4]; Shauna Onofrey, MPH[1]; Christine Agnew-Brune, PhD[4]; Michael Goulart, MPH[1]; Hongwei Jia, PhD[4]; Matthew Tumpney, ScM[1]; Paul McClung, MD[4]; Sharoda Dasgupta, PhD[4]; Danae Bixler, MD[6]; Kischa Hampton, MSW[4]; Amy Board, DrPH[7]; Jenifer Leaf Jaeger, MD[2]; Kate Buchacz, PhD[4]; Alfred DeMaria Jr., MD[1] (View author affiliations)

View suggested citation

From 2000 to 2014, the number of annual diagnoses of human immunodeficiency virus (HIV) infection in Massachusetts declined 47% (*1*). In August 2016, however, the Massachusetts Department of Public Health (MDPH) received reports of five new HIV cases among persons who inject drugs from a single community health center in the City of Lawrence (*2*). On average, less than one case per month among persons who inject drugs had been reported in Lawrence during 2014–2015 from all providers. Surveillance identified additional cases of HIV infection among such persons linked to Lawrence and Lowell, in northeastern Massachusetts, during 2016–2017. In 2018, MDPH and CDC conducted an investigation to characterize the outbreak and recommend control measures.

Investigators reviewed surveillance data and HIV-1 polymerase (*pol*) gene nucleotide sequences derived from drug resistance testing and interviewed persons with HIV infection in northeastern Massachusetts. Cases were defined as diagnoses of HIV infection in northeastern Massachusetts during January 2015–May 2018 in 1) a person who injects drugs who received medical care, experienced homelessness, resided, or injected drugs in Lawrence or Lowell; 2) a person who was epidemiologically linked as an injecting or sex partner of a person with HIV infection connected to Lawrence or Lowell; or 3) a person with an HIV-1 *pol* nucleotide sequence molecularly linked at a genetic distance of ≤1.5% (as determined by pairwise sequence analysis) to that of another person in the investigation who was connected to Lawrence or Lowell. Qualitative interviews were conducted with a purposeful sample of 34 persons who inject drugs to assess risk factors for HIV infection and with 19 clinicians and other stakeholders in Lawrence and Lowell to identify available medical and social services.

Figure

References

Related Materials

[PDF]

As of June 30, 2018, a total of 129 persons meeting the case definition were identified; 74 (57%) were male, 94 (73%) were aged 20–39 years at diagnosis, 87 (67%) were non-Hispanic white, and 38 (29%) were Hispanic. Most (114; 88%) reported a history of injection drug use (Figure), including four (3%) who also reported male-to-male sexual contact; 116 (90%) had laboratory evidence of past or current hepatitis C virus infection. Median CD4+ cell count at diagnosis was 550 cells/μL (range = 1–1,470), suggestive of a number of recent infections (*3*). Molecular analysis aided case identification: 28 (22%) cases had epidemiologic links only; 69 (53%) had both epidemiologic and molecular links; and 32 (25%) had molecular links only. Four clusters of ≥5 cases were identified using molecular links; two of these clusters accounted for 78 (60%) cases.

In qualitative interviews, the 34 persons who inject drugs variously identified opioids alone, stimulants (i.e., cocaine and methamphetamine) alone, or both opioids and stimulants as their drugs of choice. Sharing syringes and other equipment, experiencing homelessness, being incarcerated, or exchanging sex for drugs during the previous year also were reported. Stakeholders reported that fentanyl had replaced heroin in local communities, was cheaper in Lawrence than in other cities in the region, and had increased injection frequency. The reported increased frequency of fentanyl injection might have increased transmission in Lawrence and Lowell. Stakeholders also reported that frequent homelessness and incarceration among injection drug users undermined HIV treatment success because of interrupted treatment, missed appointments, and having multiple care providers. An additional challenge noted was syringe services program (SSP) accessibility. Lowell had a privately funded SSP with limited days and hours of operation; since 2017, Lawrence had a state-funded SSP with daily availability, but no weekend or evening hours.

Opioid overdose deaths have increased rapidly in Lawrence and Lowell since 2013 (*4*), with postmortem fentanyl detection increasing statewide (*5*). The presence of multiple molecular clusters and unlinked infections suggests multiple introductions of HIV among persons who inject drugs as well as recent and rapid transmission in the context of some longstanding HIV infections.

Lawrence and Lowell approved state-funded SSPs in 2016 and 2018, respectively. MDPH has since deployed additional field staff members to link persons with HIV infection to care and to provide partner services. MDPH and local partners are expanding services that address social instability attributable to homelessness and incarceration and increase knowledge about safer injection practices among persons who inject drugs. MDPH will continue HIV testing, field investigation, and molecular cluster detection and response statewide.

Top

Corresponding author: Kevin Cranston, kevin.cranston@state.ma.us, 617-938-4014.

Top

---

[1]Bureau of Infectious Disease and Laboratory Sciences, Massachusetts Department of Public Health; [2]Infectious Disease Bureau, Boston Public Health Commission, Boston, Massachusetts; [3]Epidemic Intelligence Service, CDC; [4]Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [5]Division of Global HIV and TB Prevention, Center for Global Health, CDC; [6]Division of Viral Hepatitis, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [7]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee.

Top

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. Nivedha Panneer reports stock ownership in Gilead. Shauna Onofrey reports that a family member works for and owns stock in Emergent Biosolutions. No other potential conflicts of interest were disclosed.

Top

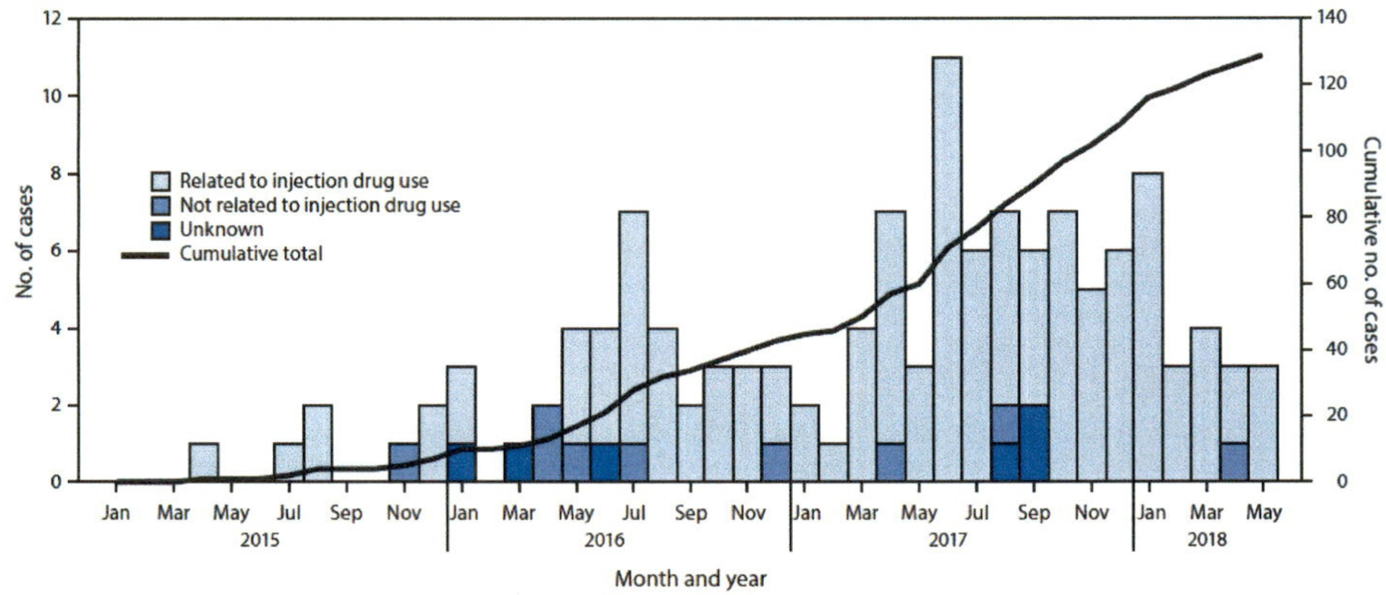
References

1. Cranston K, John B, Fukuda HD, et al. Sustained reduction in HIV diagnoses in Massachusetts, 2000–2014. Am J Public Health 2017;107:794–9. CrossRef PubMed
2. Massachusetts Department of Public Health. 2017 Massachusetts HIV/AIDS epidemiologic profile: people who inject drugs (PWID). Jamaica Plain, MA: Massachusetts Department of Public Health; 2018. https://www.mass.gov/doc/people-who-inject-drugs-pwid-data-as-of-1117/download

3. Lodi S, Phillips A, Touloumi G, et al. Time from human immunodeficiency virus seroconversion to reaching CD4+ cell count thresholds <200, <350, and <500 cells/mm3: assessment of need following changes in treatment guidelines. Clin Infect Dis 2011;53:817–25. CrossRef PubMed
4. Massachusetts Department of Public Health. Number of opioid-related overdose deaths, all intents by city/town 2013–2017. Boston, MA: Massachusetts Department of Public Health; 2018. https://www.mass.gov/files/documents/2018/05/22/Opioid-related%20Overdose%20Deaths%20by%20City%20Town%20-%20May%202018_0.pdf
5. Massachusetts Department of Public Health. Data brief: opioid-related overdose deaths among Massachusetts residents. Boston, MA: Massachusetts Department of Public Health; 2018. https://www.mass.gov/files/documents/2018/05/22/Opioid-related%20Overdose%20Deaths%20among%20MA%20Residents%20-%20May%202018.pdf

Top
Return

FIGURE. Human immunodeficiency virus diagnoses linked to Lawrence and Lowell, Massachusetts, January 2015–May 2018



Top

Suggested citation for this article: Cranston K, Alpren C, John B, et al. *Notes from the Field:* HIV Diagnoses Among Persons Who Inject Drugs — Northeastern Massachusetts, 2015–2018. MMWR Morb Mortal Wkly Rep 2019;68:253–254. DOI: http://dx.doi.org/10.15585/mmwr.mm6810a6.

Massachusetts Department of Public Health
Bureau of Infectious Disease and Laboratory Sciences

Update on the Lowell/Lawrence HIV Outbreak Among People who Inject Drugs

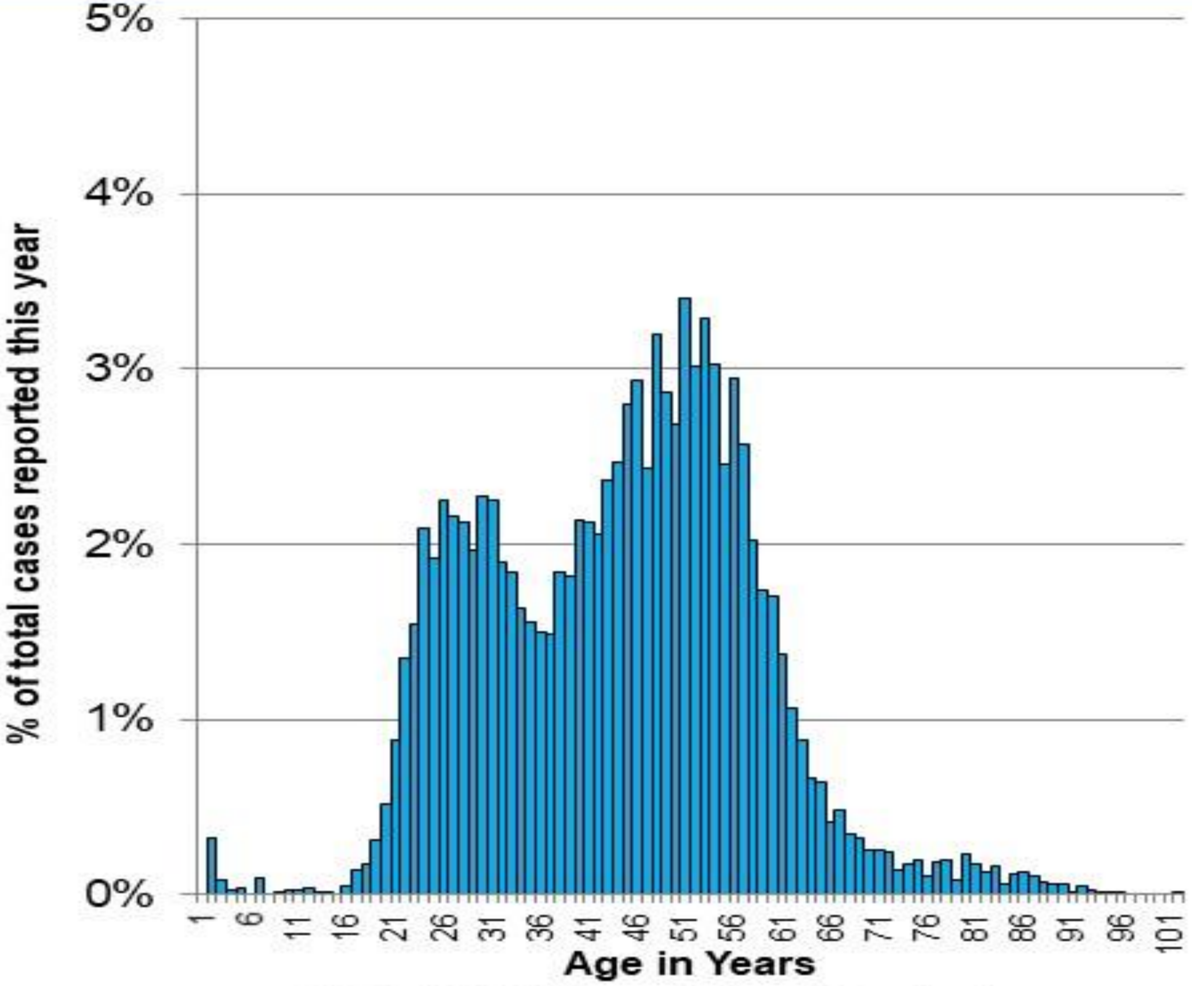
Massachusetts Public Health Council
April 3, 2019

Kevin Cranston, MDiv
Assistant Commissioner
Director, Bureau of Infectious Disease and Laboratory Sciences
Massachusetts Department of Public Health

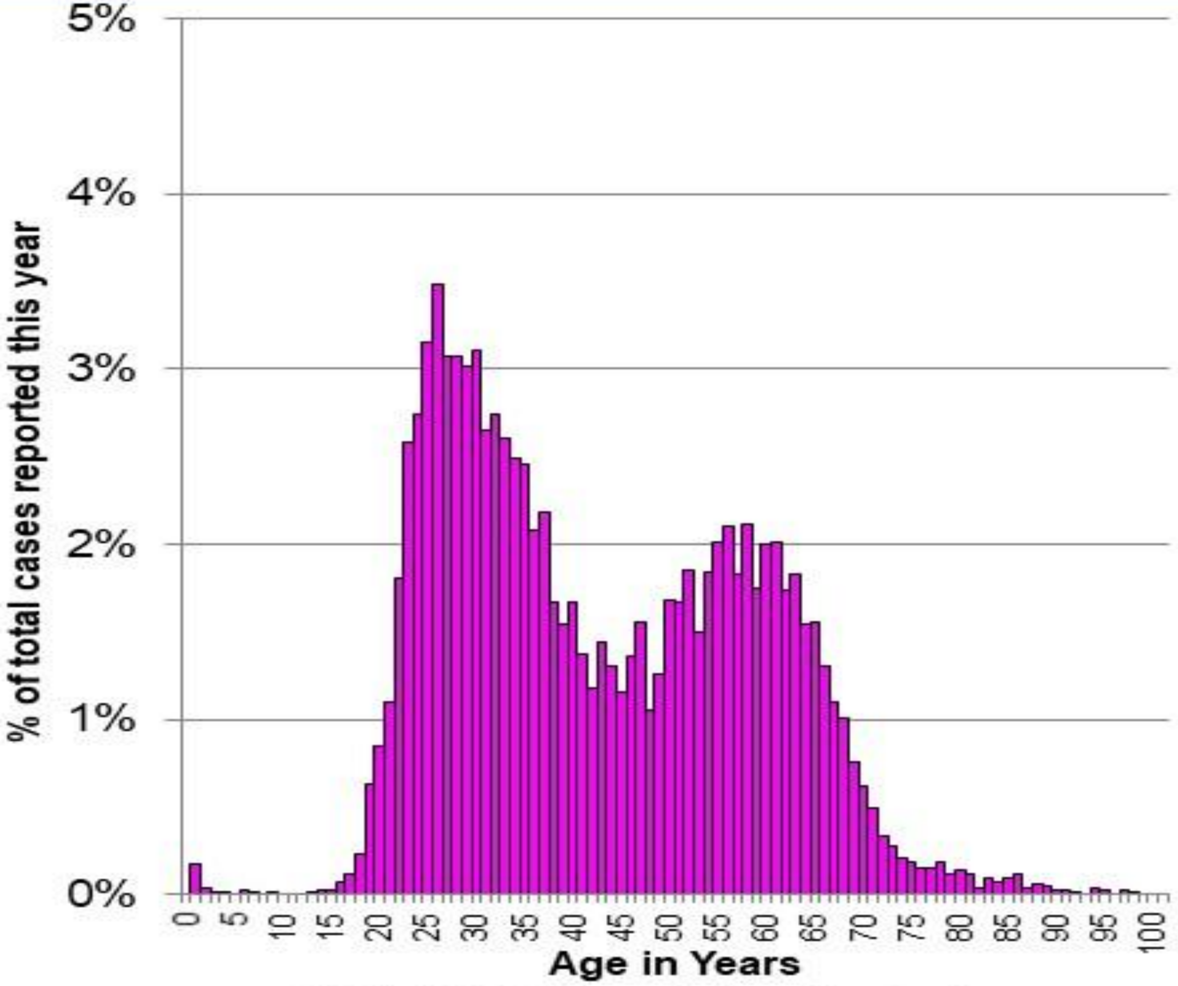
Where it all started: under the Casey Bridge in Lawrence


GREATER LAWRENCE FAMILY HEALTH CENTER
COMMUNITY SUPPORT SERVICES
100

Distribution of Confirmed and Probable Hepatitis C Cases by Age: 2007 Versus 2015



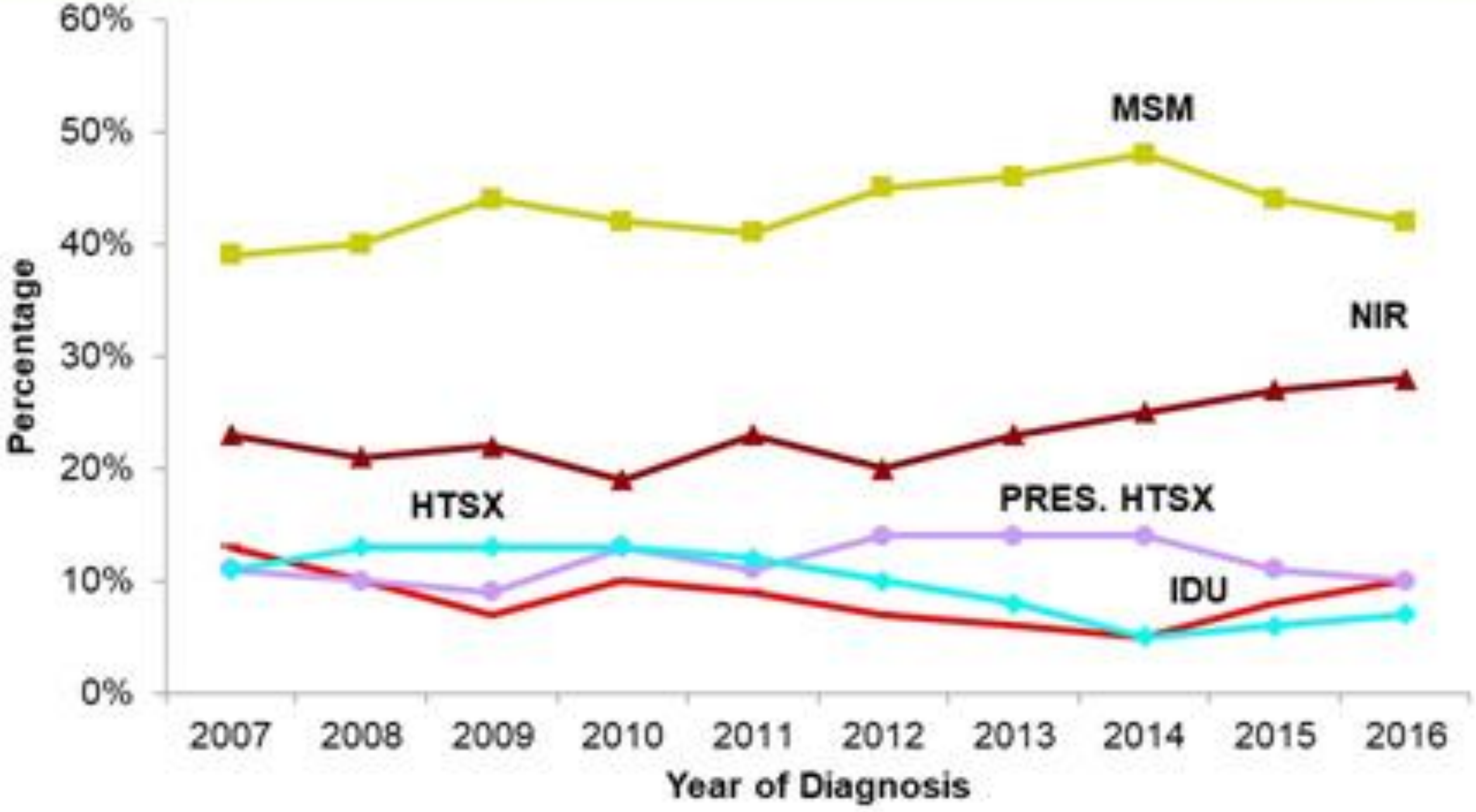
2007: N=8,649, excludes 476 missing



2015: N=9,026, excludes 16 missing

Data Source: MDPH, Bureau of Infectious Disease and Laboratory Sciences, data are current as of 8/9/17 and subject to change

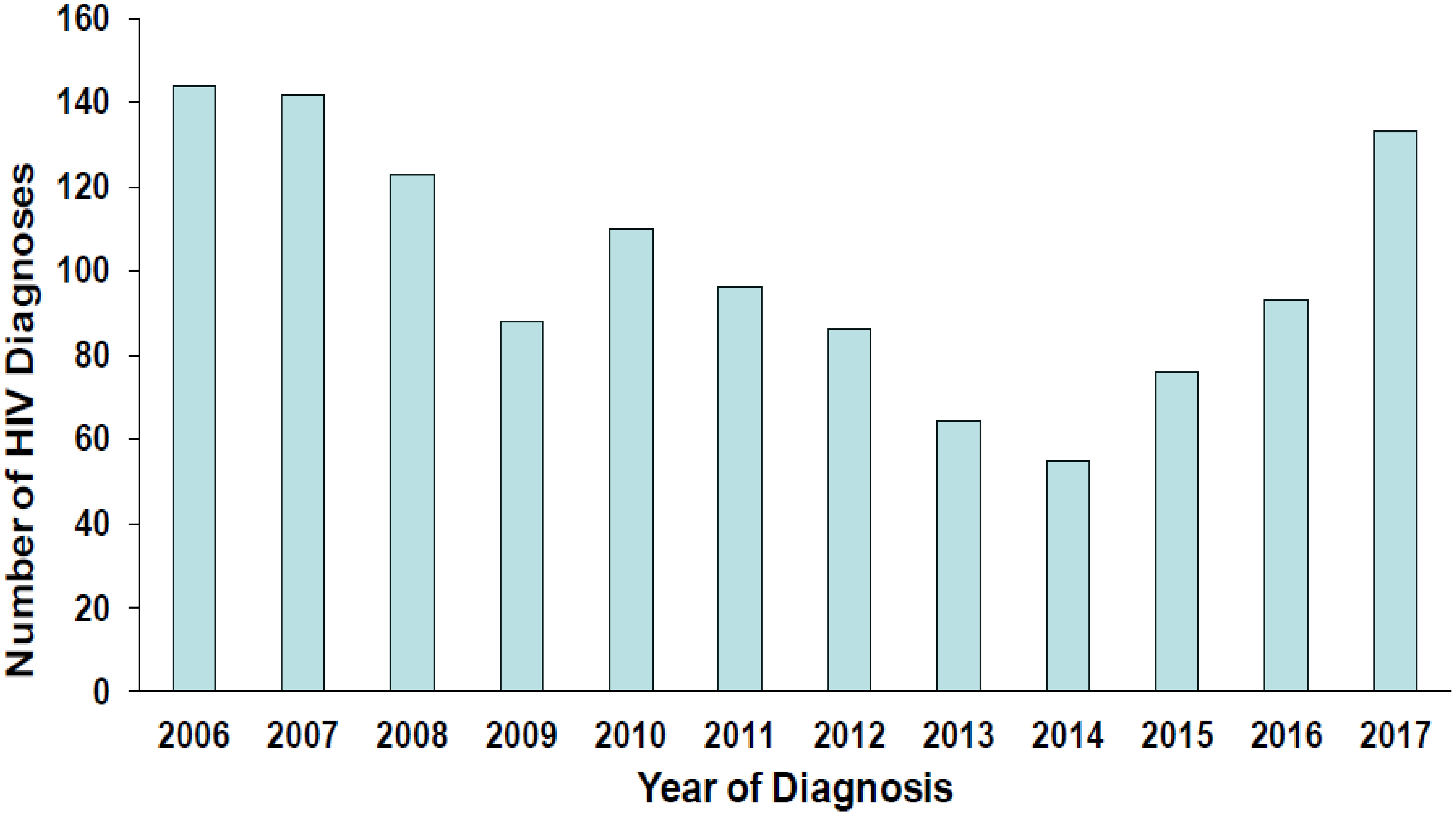
Trends in the Percentage Distribution of Individuals Diagnosed with HIV Infection by Selected Exposure Mode[1] and Year of Diagnosis: Massachusetts, 2007–2016



[1] Values less than five are suppressed to protect privacy

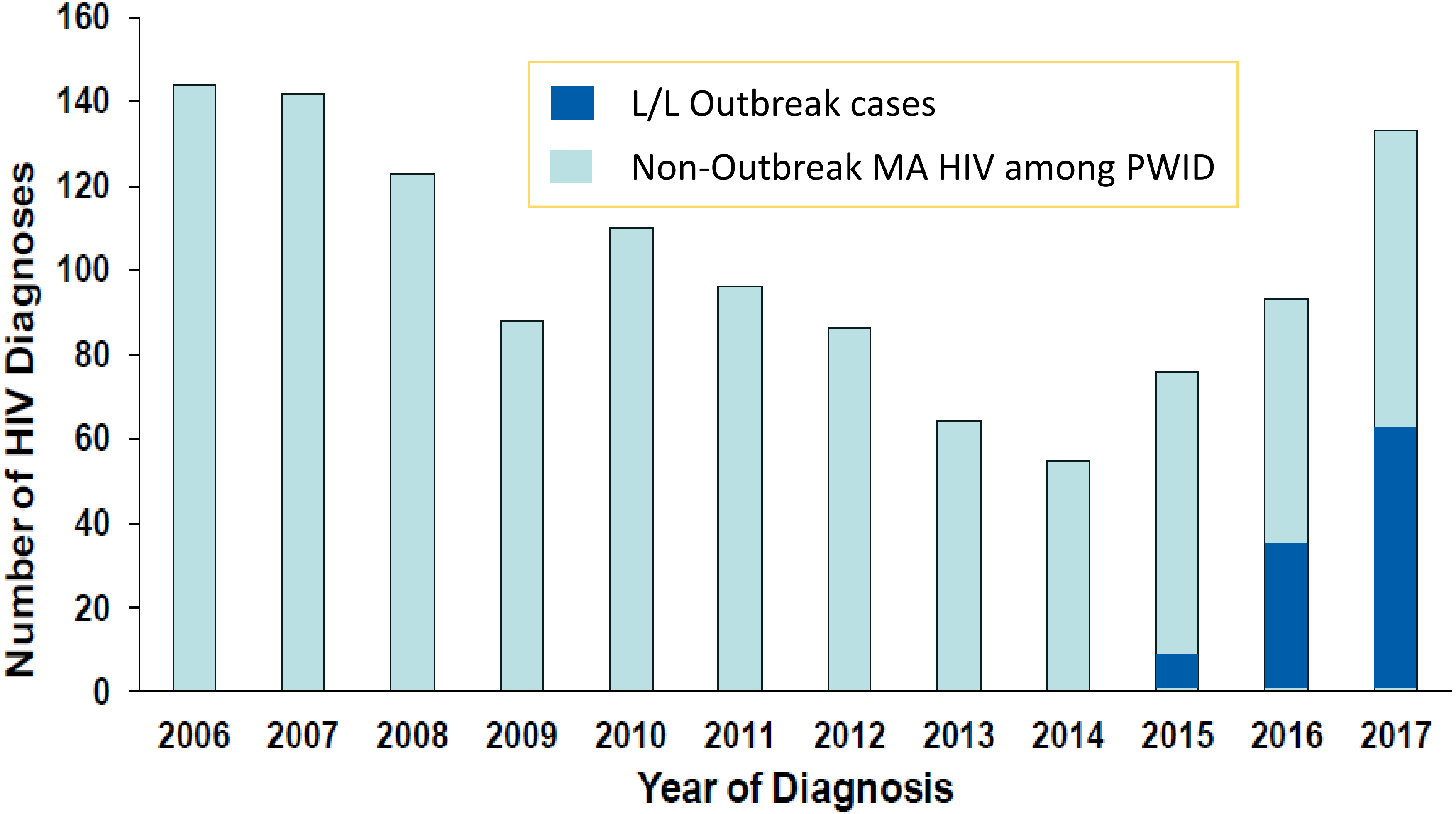
N=6,972, 2007–2016; HTSX=heterosexual sex, IDU=injection drug use, MSM=Male-to-male sex, NIR=no identified risk,, Pres. HTSX=Presumed Heterosexual Sex, Data Source: MDPH Bureau of Infectious Disease and Laboratory Sciences; Data as of 1/1/18

Diagnoses of HIV among PWID had been decreasing in MA through 2014
These diagnoses have been increasing since 2015



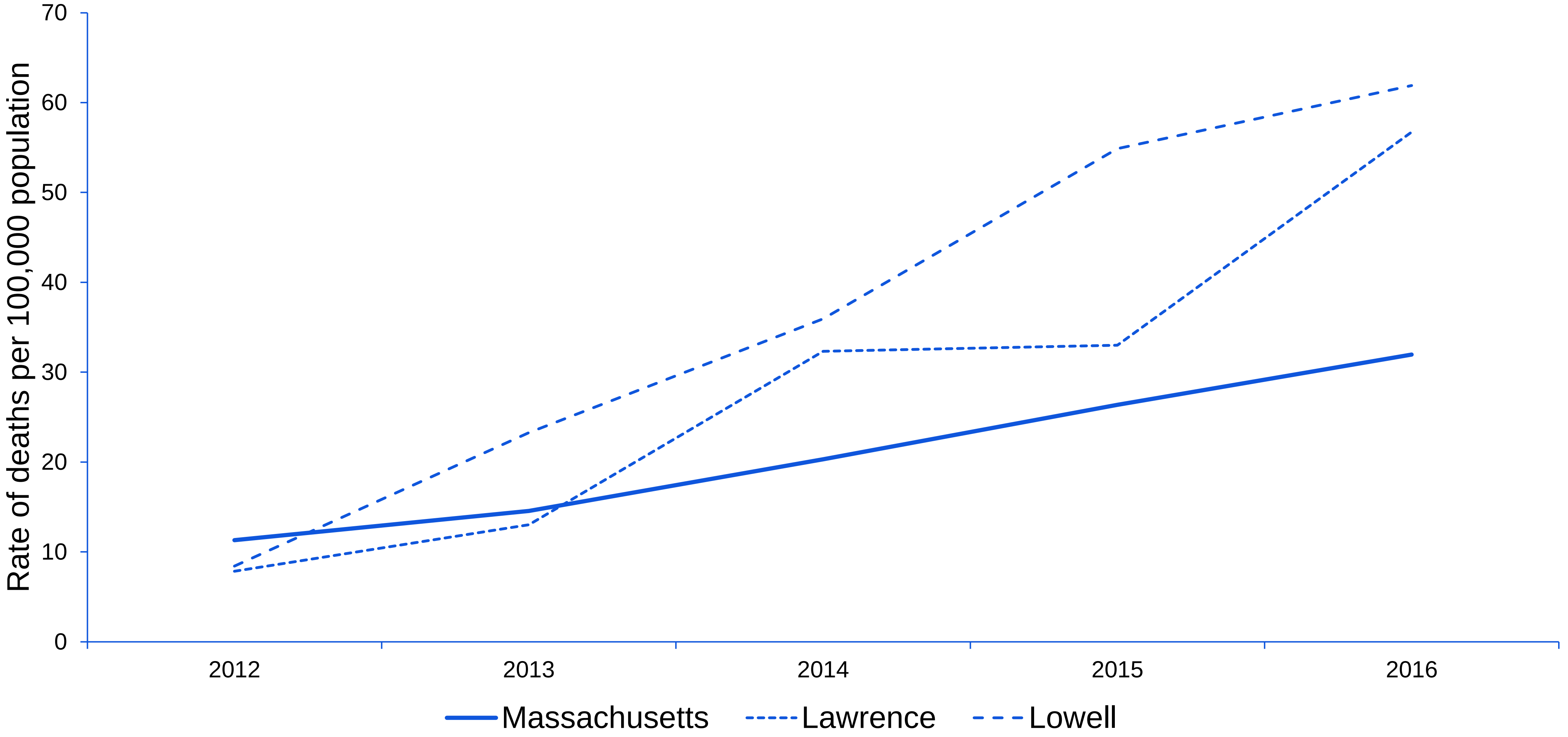
MDPH HIV/AIDS surveillance program, data as of 5/1/18

Outbreak in Lawrence and Lowell accounted for an increasing proportion of HIV infections among PWID in Massachusetts 2015-2017

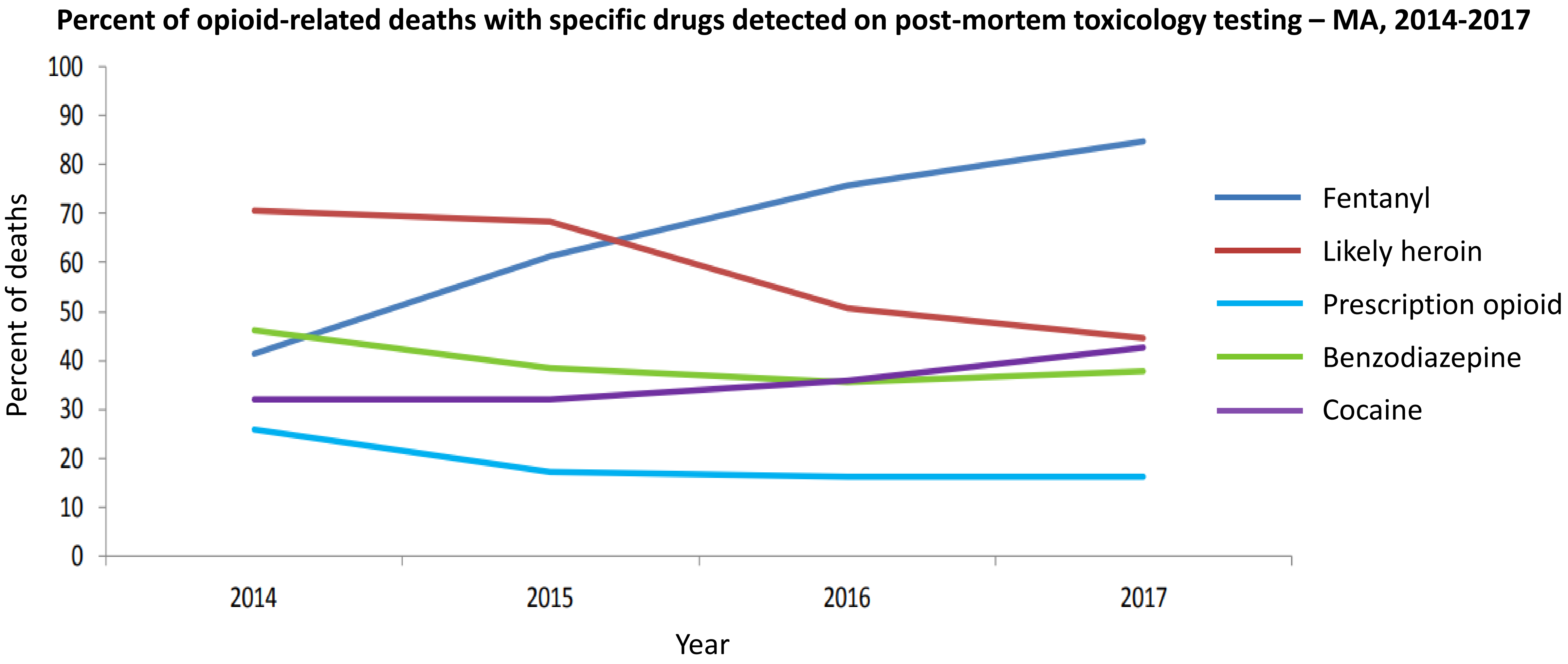


MDPH HIV/AIDS surveillance program, data as of 5/1/18

Fatal opioid overdoses increased over time in Massachusetts through 2016
Higher rates of increase seen in Lowell/Lawrence



Fentanyl detection increased among fatal opioid overdoses Massachusetts 2014-2017



MDPH Data Brief, May 2018

Principle risk: OVERDOSE

"If I don't have a needle, they did but it was already used and they'd be like "do you care?" and I was like no. And I only said no only being like dope sick or just wanting the next fix."

"We were all taught it's gonna die after, like, 3 or 5 seconds after hitting the air. So we would pull out the plunger and just like wait and then put it back in and use it."

"I shoot up and then next thing I know I'm feeling really sick, and I start talking… to my girlfriend, like "was there like coke in this dope? stay away from me, I'm mad at you." I was pissed at her… And then she's like "I just narcan'ed you twice.""

Misconceptions of risk

"If I don't have a needle, they did but it was already used and they'd be like "do you care?" and I was like no. And I only said no only being like dope sick or just wanting the next fix."

"I shoot up and then next thing I know I'm feeling really sick, and I start talking… to my girlfriend, like "was there like coke in this dope? stay away from me, I'm mad at you." I was pissed at her… And then she's like "I just narcan'ed you twice.""

"We were all taught it's gonna die after, like, 3 or 5 seconds after hitting the air. So we would pull out the plunger and just like wait and then put it back in and use it."

Low threshold for risk taking

"If I don't have a needle, they did but it was already used and they'd be like "do you care?" and I was like no. And I only said no only being like dope sick or just wanting the next fix."

"We were all taught it's gonna die after, like, 3 or 5 seconds after hitting the air. So we would pull out the plunger and just like wait and then put it back in and use it."

"I shoot up and then next thing I know I'm feeling really sick, and I start talking… to my girlfriend, like "was there like coke in this dope? stay away from me, I'm mad at you." I was pissed at her… And then she's like "I just narcan'ed you twice.""

The Case Definition

HIV infection diagnosed January 2015 to June 2018

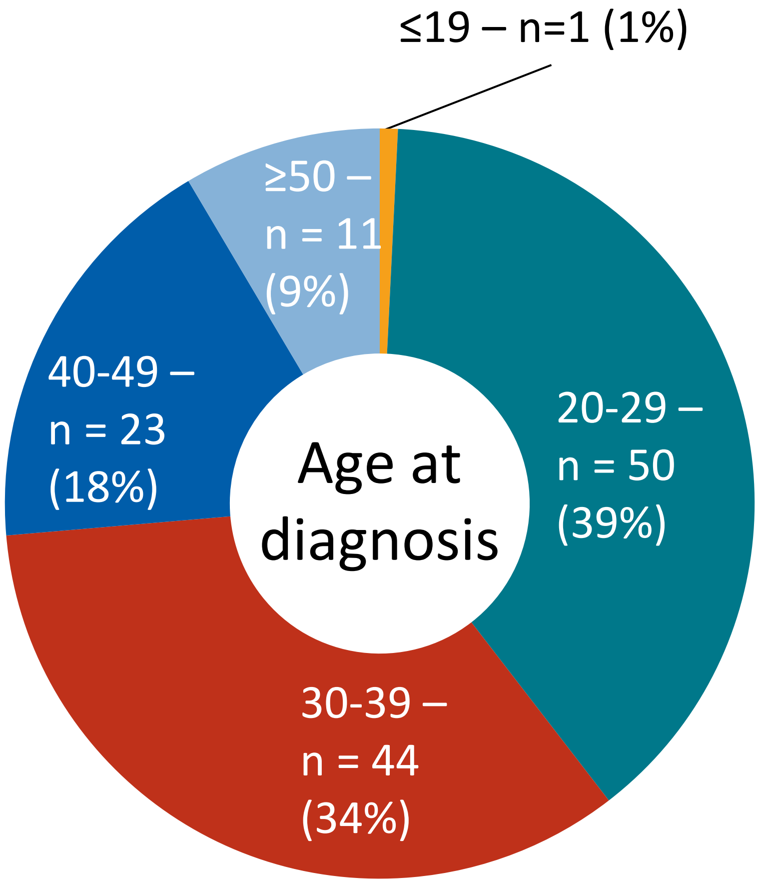
Epidemiological Criteria

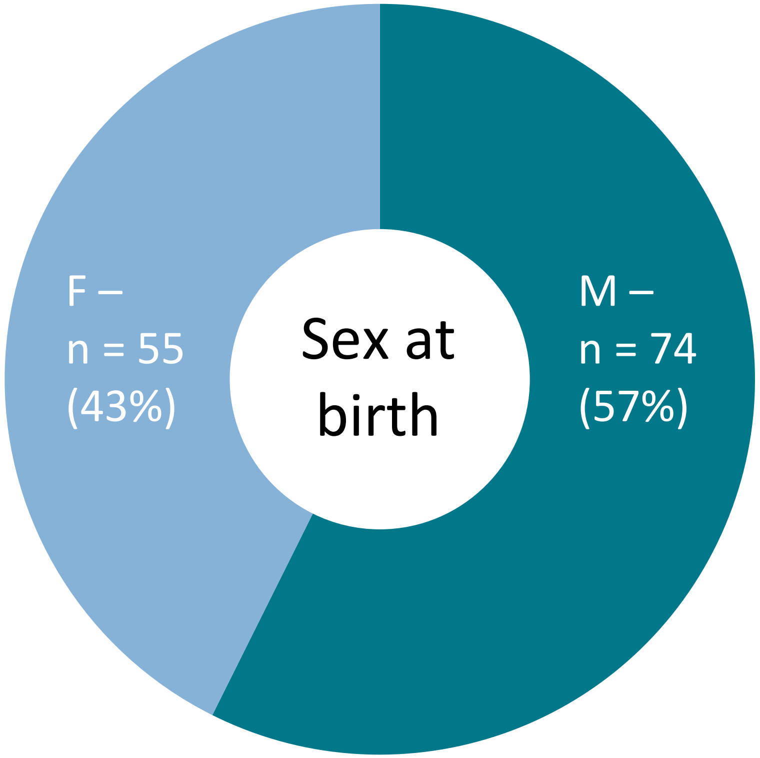
Molecular Criteria

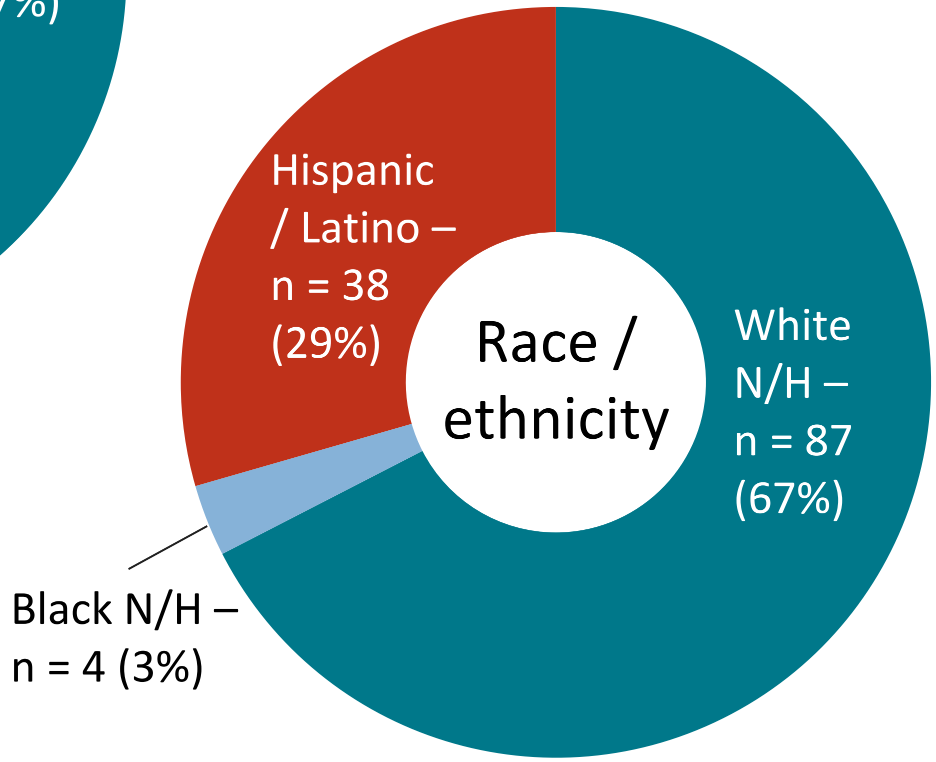
In a person who injects drugs who….

in Lawrence or Lowell

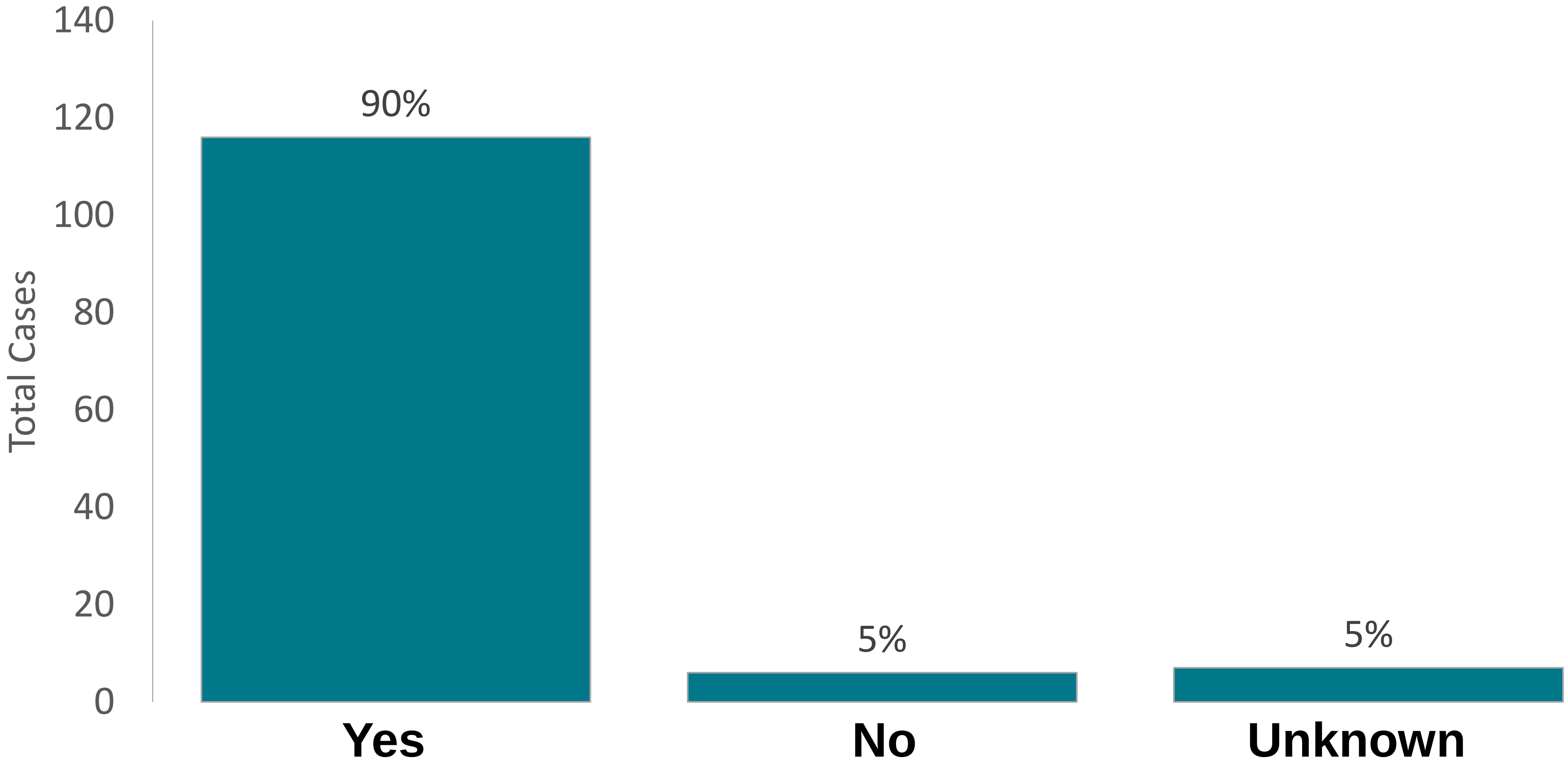
Case Demographics





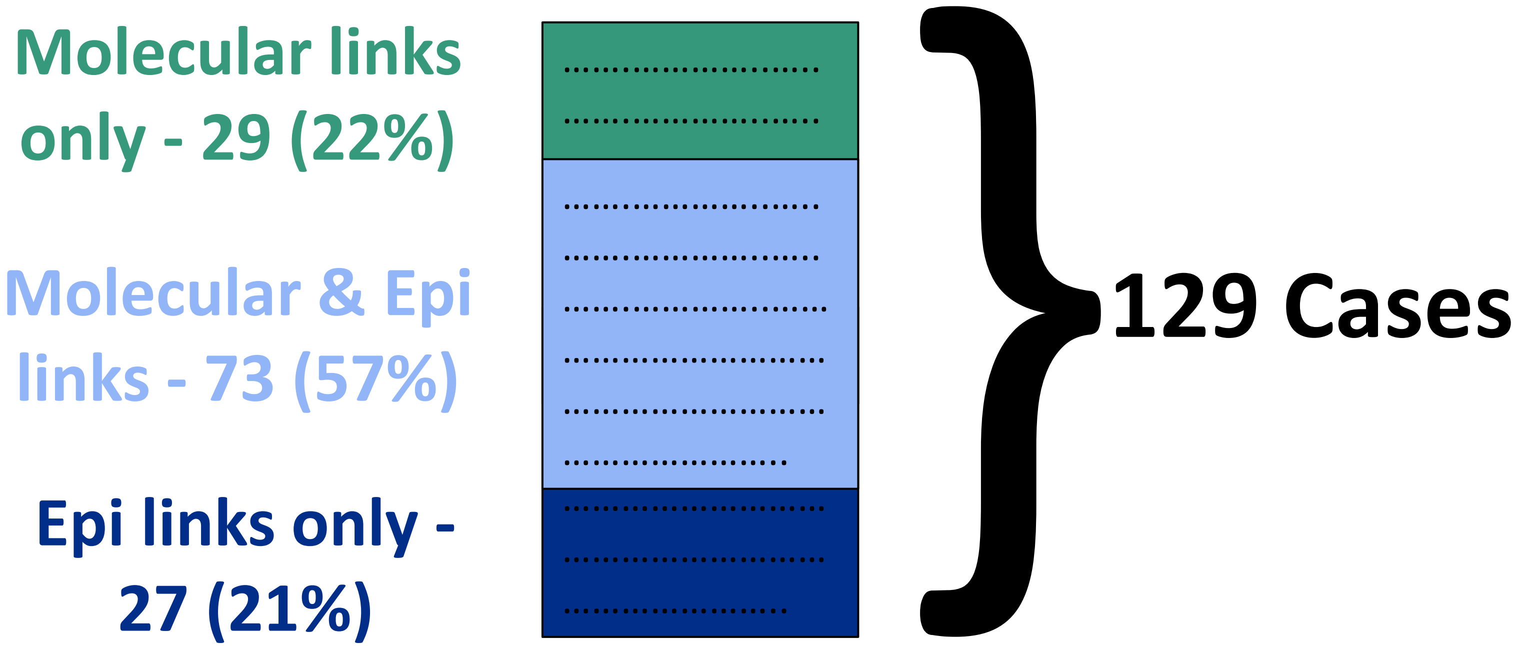


Most cases had evidence of current or past hepatitis C infection.

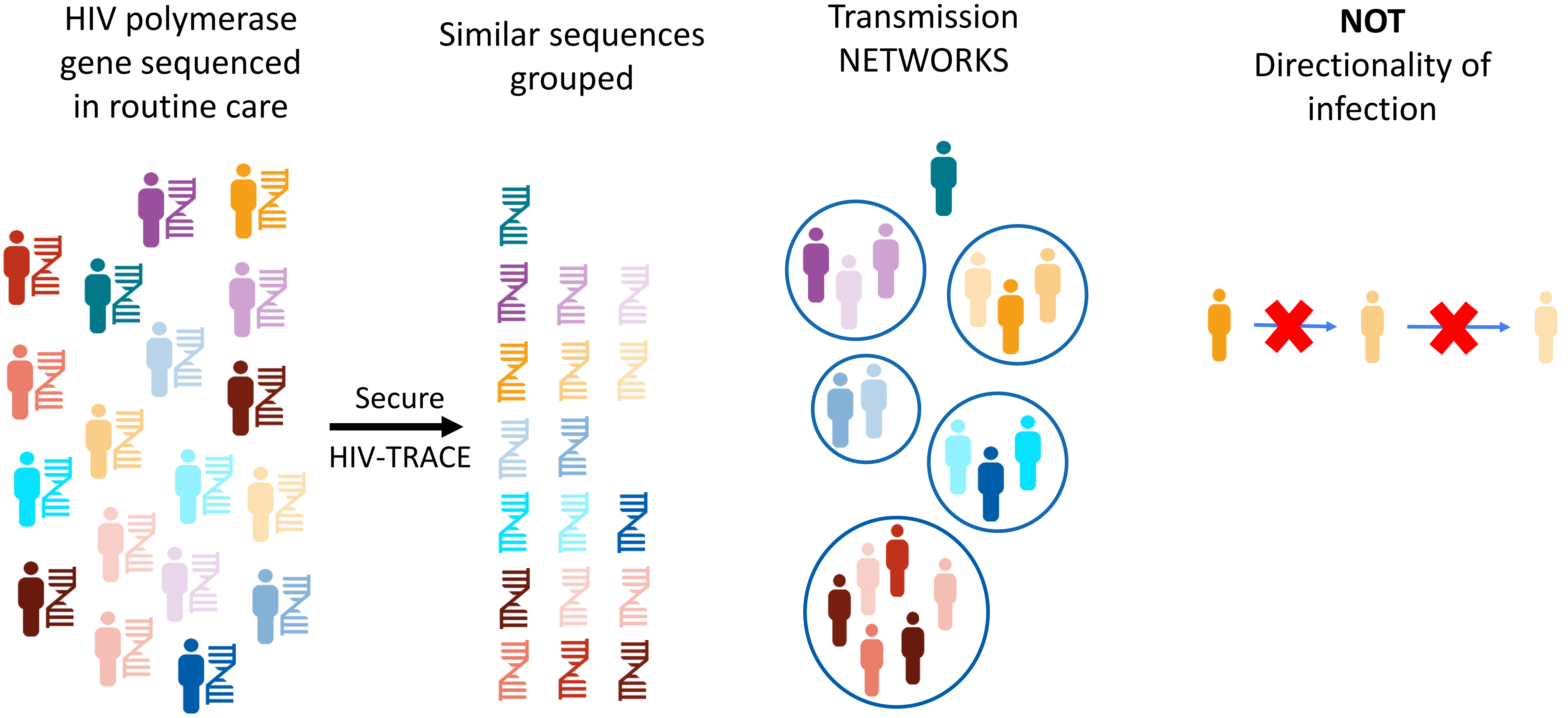


Data as of 7-11-2018

Molecular analysis linked many new cases to the investigation.

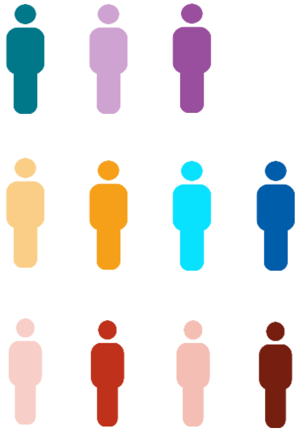


Molecular surveillance is used to determine transmission networks

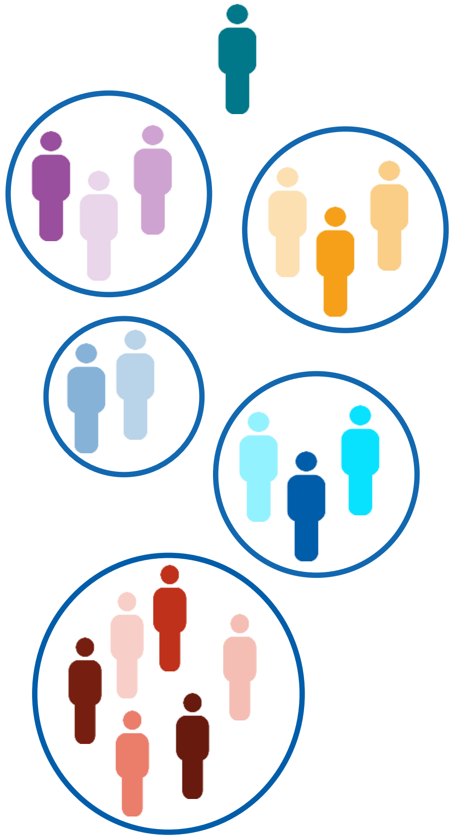


Molecular surveillance is used to determine transmission networks and link cases to an outbreak.

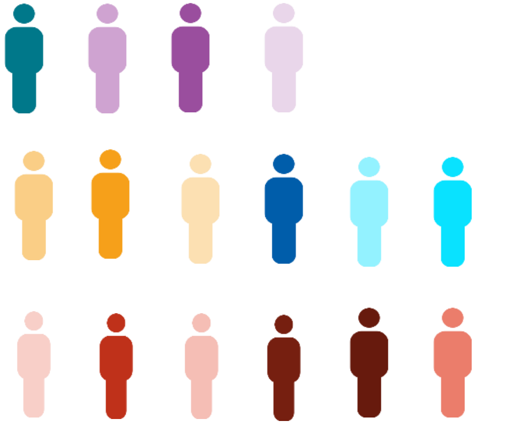
Initial outbreak
line-list



Transmission networks identified
through molecular analysis

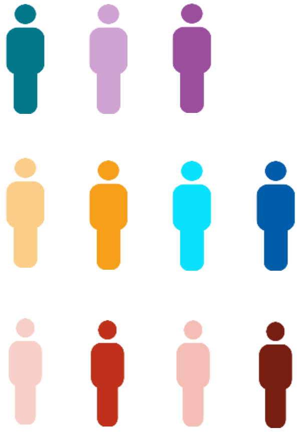


Add cases in same network
as others with known epi link



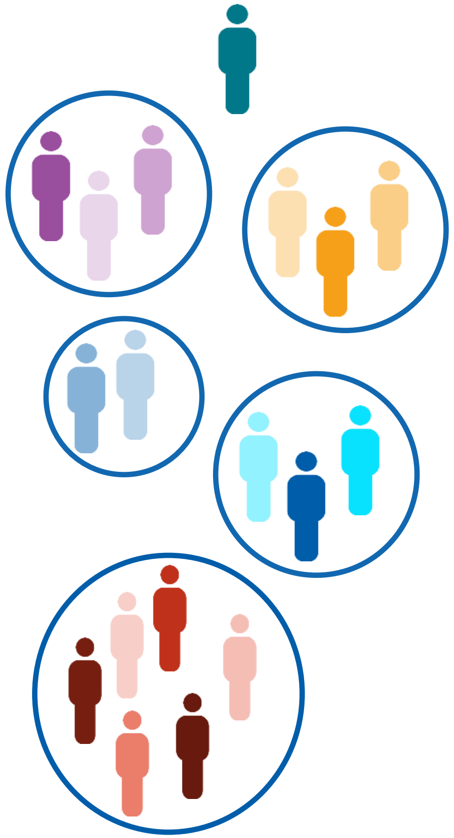
Molecular analysis linked many new cases to this investigation.

Initial outbreak line-list

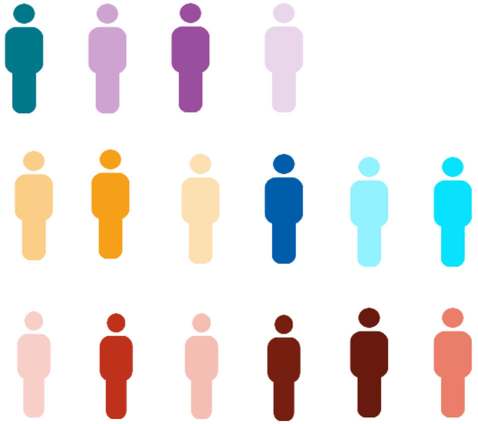


86 cases on initial line list

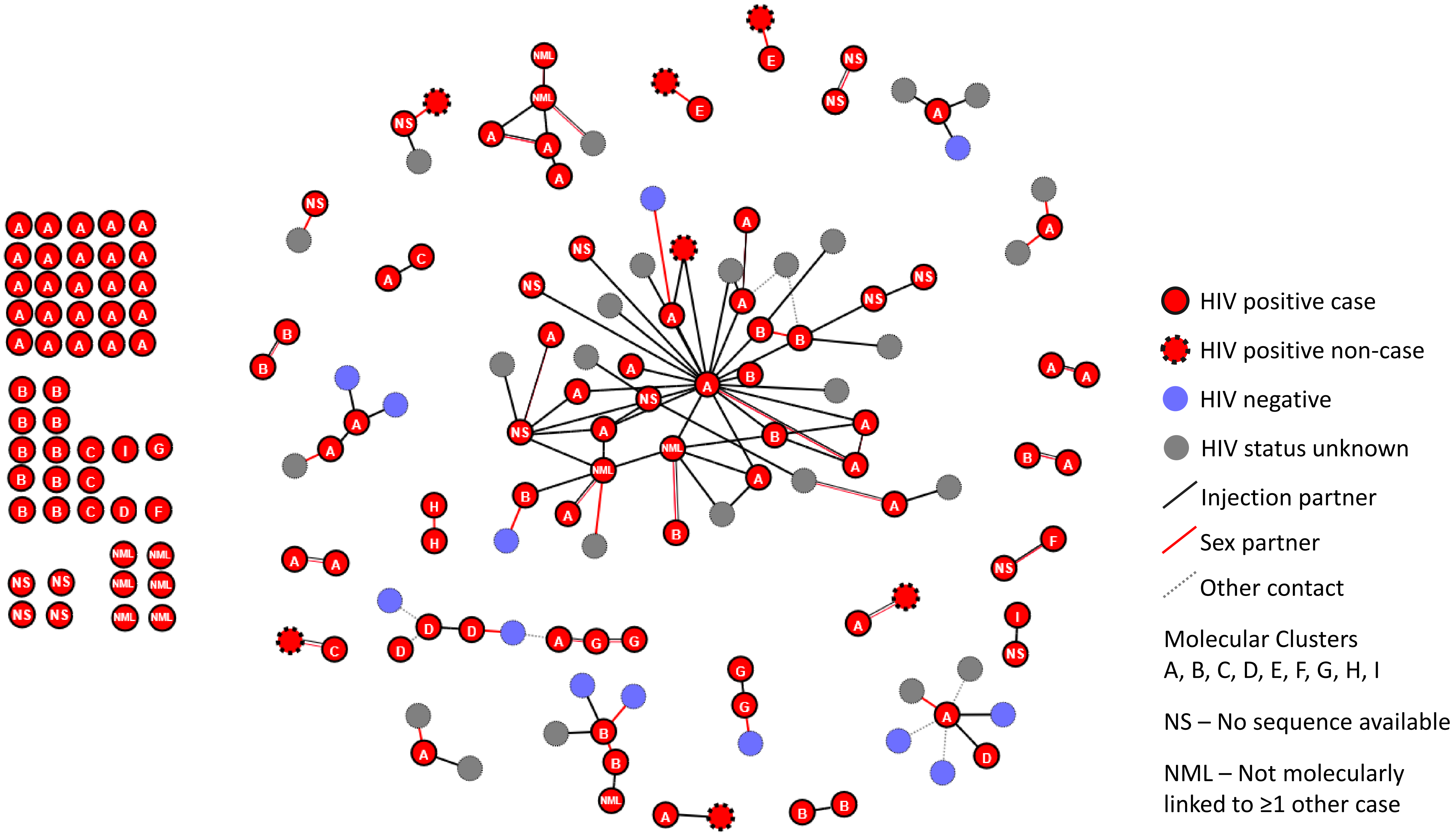
Transmission networks identified through molecular analysis



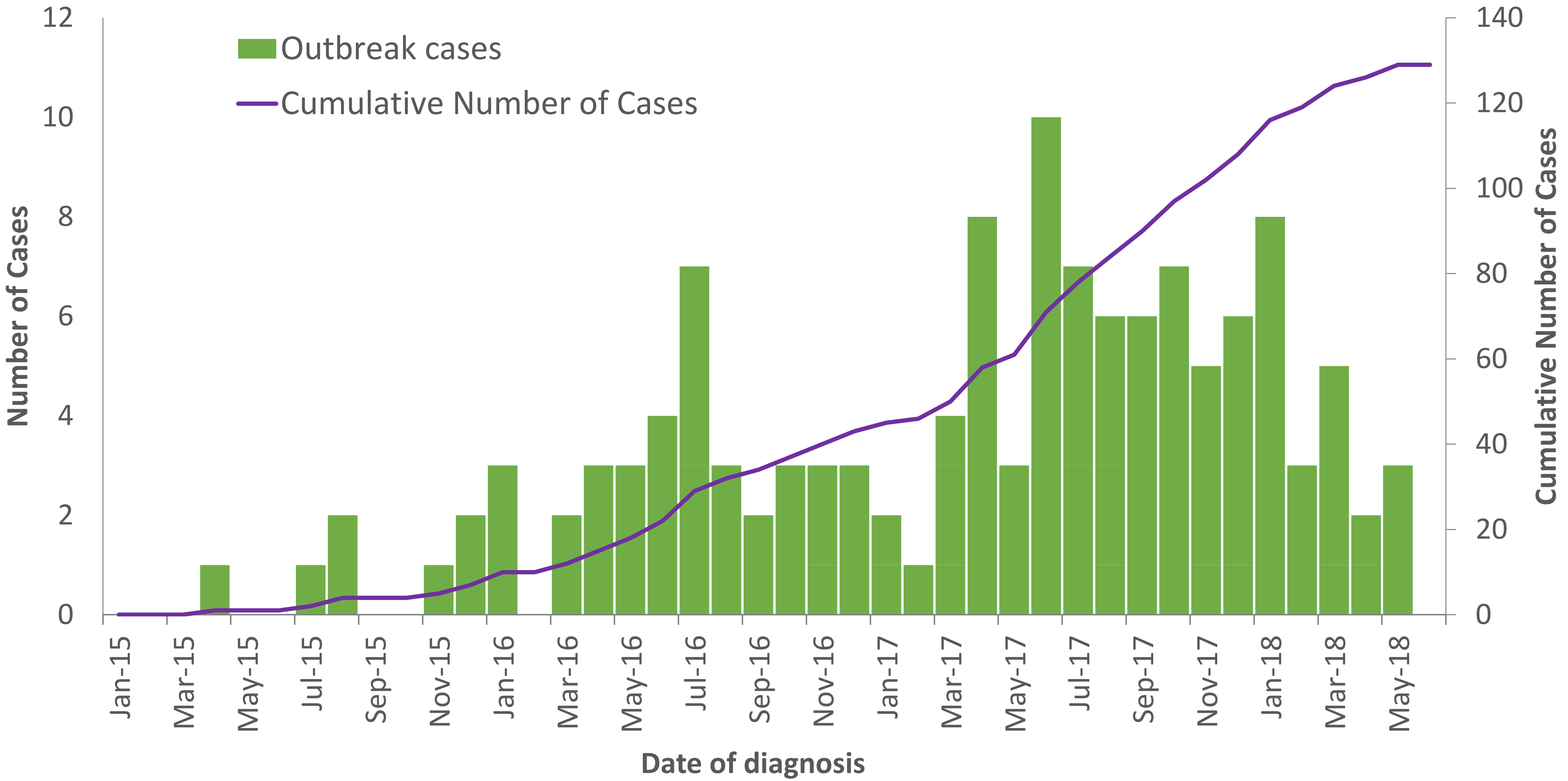
Add cases in same network as others with known epi link



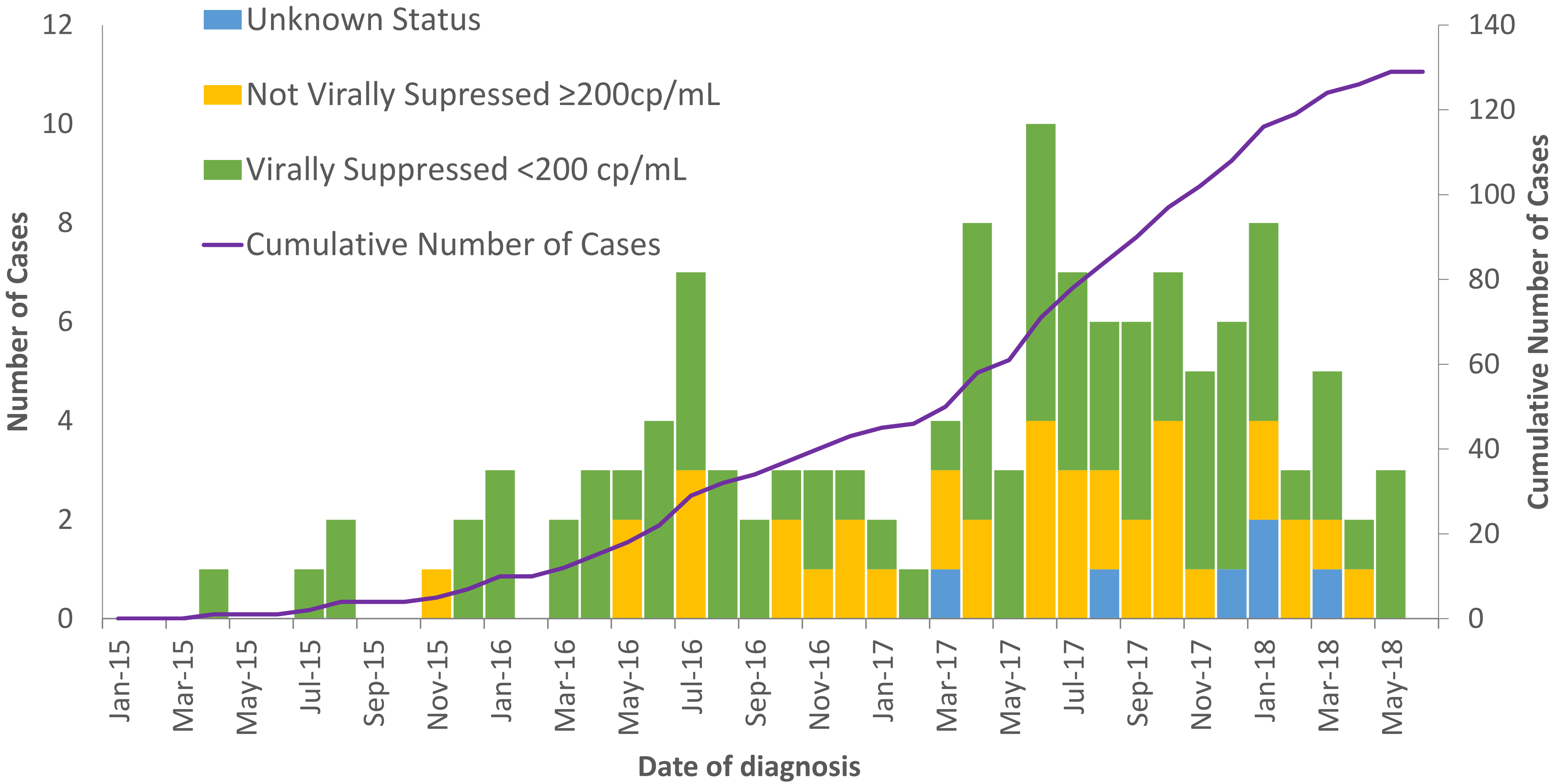
129 cases epidemiologically or molecularly linked


HIV positive case
HIV positive non-case
HIV negative
HIV status unknown
Injection partner
Sex partner
Other contact
Molecular Clusters
A, B, C, D, E, F, G, H, I
NS – No sequence available
NML – Not molecularly linked to ≥1 other case

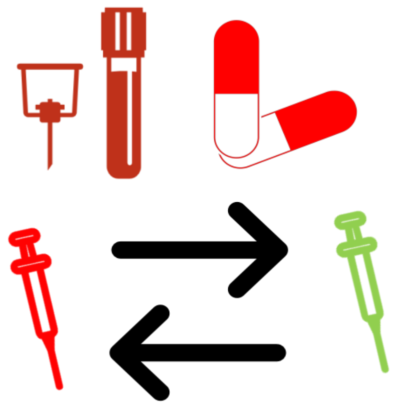
Lowell/Lawrence HIV Cluster Epi Curve



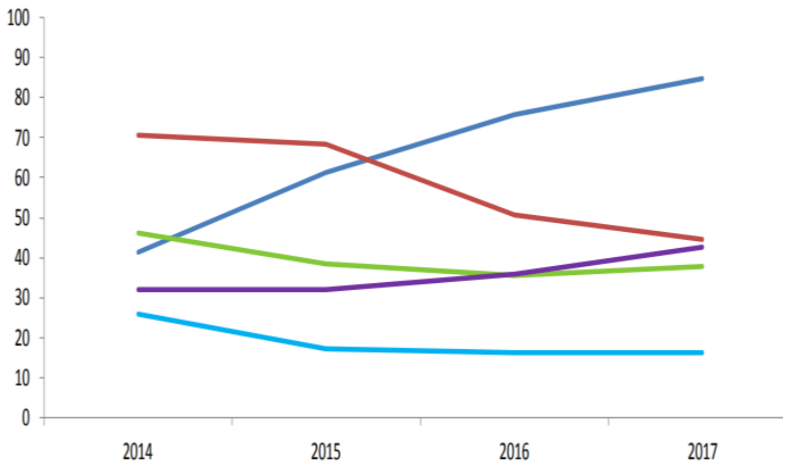
Viral Suppression among Lowell/Lawrence Cluster Cases



Conclusions



HIV has emerged despite availability of services



Fentanyl has increased opportunity for HIV transmission through more frequent injection

Molecular surveillance helped characterize the outbreak

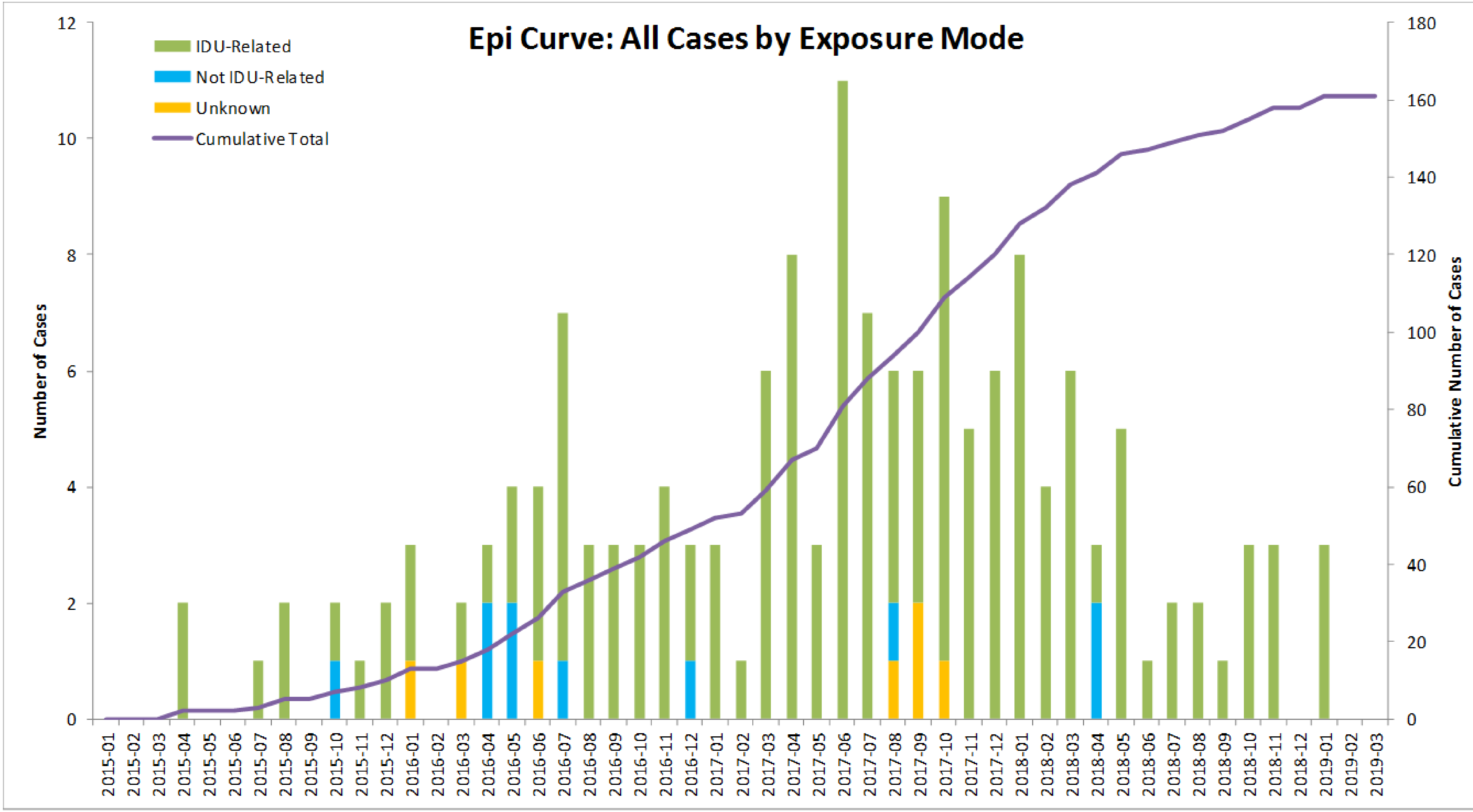
Partnerships with community stakeholders vital

Public Health Response:

- **Clinical alerts (and attendant media)**
  - Statewide alert about increasing HIV diagnoses in PWID (November 2017)
  - Joint alert with City of Boston about new HIV cluster in PWID (January 2019)
  - Following identification of Worcester PWID cluster, statewide outbreak declaration (February 2019)
- **Stakeholder engagement**
  - local health, first responders, clinicians, HIV services providers, homeless services providers
- **Epi Aid support from CDC (started May 2018)**
  - Boston Public Health Commission lent their assigned EIS Officer, Dr. Charles Alpren
- **Molecular HIV surveillance initiated**
  - Increased case count linked to Lowell/Lawrence by 50%
- **Stakeholder and user interviews**
  - Source of considerable contextual information
- **Doubled state field epidemiology capacity**
  - Follow-up on all newly diagnosed and out-of-care HIV cases
- **$1.7M contractual investment in region**
  - expanded testing and linkage services, new/expanded SSPs, user-level harm reduction materials, shelter support, first responder training on MAT access, additional ethnographic investigation

Locally approved Syringe Services Programs in Massachusetts (as of March 2019, n=33)

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH



Epi Curve: All Cases by Exposure Mode
IDU-Related
Not IDU-Related
Unknown
Cumulative Total
Number of Cases
Cumulative Number of Cases
0
2
4
6
8
10
12
0
20
40
60
80
100
120
140
160
180
2015-01
2015-02
2015-03
2015-04
2015-05
2015-06
2015-07
2015-08
2015-09
2015-10
2015-11
2015-12
2016-01
2016-02
2016-03
2016-04
2016-05
2016-06
2016-07
2016-08
2016-09
2016-10
2016-11
2016-12
2017-01
2017-02
2017-03
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
2017-12
2018-01
2018-02
2018-03
2018-04
2018-05
2018-06
2018-07
2018-08
2018-09
2018-10
2018-11
2018-12
2019-01
2019-02
2019-03

Thank you

kevin.cranston@state.ma.us

BOH 2/5/20

AJPH
A PUBLICATION OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

Opioid Use Fueling HIV Transmission in an Urban Setting: An Outbreak of HIV Infection Among People Who Inject Drugs—Massachusetts, 2015–2018

Charles Alpren MBChB, MPH, **Erica L. Dawson** PhD, **Betsey John** MPH, **Kevin Cranston** MDiv, **Nivedha Panneer** MPH, **H. Dawn Fukuda** ScM, **Kathleen Roosevelt**
... (show all authors)

[+] Author affiliations, information, and correspondence details

Accepted: August 21, 2019 Published Online: December 04, 2019

ARTICLE CITATION

Charles Alpren et al. "Opioid Use Fueling HIV Transmission in an Urban Setting: An Outbreak of HIV Infection Among People Who Inject Drugs—Massachusetts, 2015–2018", *American Journal of Public Health* 110, no. 1 (January 1, 2020): pp. 37-44.

https://doi.org/10.2105/AJPH.2019.305366

Abstract

Section: Choose

Objectives. To describe and control an outbreak of HIV infection among people who inject drugs (PWID).

Methods. The investigation included people diagnosed with HIV infection during 2015 to 2018 linked to 2 cities in northeastern Massachusetts epidemiologically or through molecular analysis. Field activities included qualitative interviews regarding service availability and HIV risk behaviors.

Results. We identified 129 people meeting the case definition; 116 (90%) reported injection drug use. Molecular surveillance added 36 cases to the outbreak not otherwise linked. The 2 largest molecular groups contained 56 and 23 cases. Most interviewed PWID were homeless. Control measures, including enhanced field epidemiology, syringe services programming, and community outreach, resulted in a significant decline in new HIV diagnoses.

Conclusions. We illustrate difficulties with identification and characterization of an outbreak of HIV infection among a population of PWID and the value of an intensive response.

Public Health Implications. Responding to and preventing outbreaks requires ongoing surveillance, with timely detection of increases in HIV diagnoses, community partnerships, and coordinated services, all critical to achieving the goal of the national Ending the HIV Epidemic initiative.

PMID: 31725317

An estimated 92% of new HIV infections in the United States are transmitted by people who are either undiagnosed or diagnosed but not engaged in care.[1] Because timely initiation of antiretroviral therapy enables rapid viral suppression among people with diagnosed HIV, identifying and intervening within transmission networks can effectively prevent HIV spread and reduce incidence. To achieve the ambitious goal of ending the HIV epidemic in the United States,[1] prompt detection and response to clusters of recent and rapid transmission of HIV is increasingly important[2] and requires integration of surveillance and prevention services and use of both traditional and novel approaches to ensure people living with HIV are diagnosed and linked to care. Molecular epidemiology has been described as transformative in public health as it allows identification of pockets of ongoing transmission of HIV that contact tracing alone may be unable to detect.[2]

We describe an outbreak of HIV that occurred among people who inject drugs (PWID) in northeastern Massachusetts. The successful identification and response to this outbreak involved stakeholders from across the HIV surveillance, prevention, and treatment community in Massachusetts and included one of the first uses of HIV molecular epidemiology to describe an outbreak and guide the control efforts (K. Buchacz, Centers for Disease Control and Prevention [CDC], e-mail communication, June 11, 2019).

In August 2016, clinicians at a federally qualified health center in Lawrence, Massachusetts, notified the Massachusetts Department of Public Health (MDPH) of 5 HIV diagnoses among PWID. On average, less than 1 case of HIV infection per month among PWID had been reported in Lawrence during 2014 to 2015 from all health care providers. Subsequent investigation resulted in a focus on the cities of

Lawrence and Lowell, former textile mill towns in the Merrimack Valley of northeastern Massachusetts, with populations of approximately 80 000 and 111 000, respectively.[3] These cities have lower median incomes, higher poverty rates,[3] and higher rates of both fatal and nonfatal opioid-involved overdoses[4,5] than the Massachusetts statewide average.

Increases in opioid use, opioid-involved overdoses, and hepatitis C virus (HCV) infections in Massachusetts had raised concern for potential introduction and transmission of HIV through unsafe injection drug use (IDU) practices.[6] During 2011 to 2015 in Massachusetts, prevalence of opioid use disorder increased by approximately 50%, and the fatal opioid-involved overdose rate more than doubled[7] to approximately twice the national average in 2014.[8] During 2012 to 2013, the rate of fatal opioid-involved overdose per 100 000 population increased from 7.8 to 13.0 in Lawrence and from 8.3 to 23.3 in Lowell.[5] Increasingly, opioid-involved overdose deaths in Massachusetts involve fentanyl, a potent synthetic opioid.[7] Furthermore, the proportion of HCV cases identified among youths and young adults started to increase dramatically before 2011.[6]

Nevertheless, annual HIV diagnoses among PWID had decreased by 68% during 2006 to 2014.[9,10] Recent outbreaks of HIV have occurred among PWID in Europe,[11] and a 2015 HIV outbreak in Scott County, Indiana, also associated with the opioid crisis, occurred in a rural community in the United States.[12] However, outbreaks had not previously been identified in urban areas of the United States where resources for HIV prevention and substance use disorder treatment are typically more accessible. A cluster of HIV infection among PWID in Seattle, Washington, identified in 2018, demonstrated the vulnerability of PWID, especially those experiencing homelessness, to HIV infection.[13]

In response to the regional increase in HIV diagnoses, MDPH conducted an outbreak investigation with support from the CDC that included case finding, laboratory testing, molecular analysis of HIV gene sequences, epidemiological analysis, and interviews with PWID and local stakeholders. Investigation goals were to describe the outbreak and determine why it happened in an urban Massachusetts location after a long period of increasing opioid use and HCV burden, but with limited previous evidence of significant HIV transmission, and to recommend control measures to reduce HIV transmission among PWID.

METHODS

Section: Choose

After the initial notification by clinicians in August 2016, MDPH used HIV and HCV surveillance data to examine all HIV diagnoses among PWID in northeastern Massachusetts. As a result of the initial investigation, MDPH initiated interventions, including enhanced outreach to PWID to encourage substance use treatment and to increase HIV testing. The Lawrence Board of Health authorized a syringe services program (SSP), which opened in January 2017. In May 2017, MDPH requested remote technical assistance from CDC. During fall 2017, further increases in HIV diagnoses among PWID were reported in both Lawrence and Lowell. In November 2017, MDPH issued a clinical advisory requesting that health care providers increase vigilance for HIV among PWID.[14] MDPH held stakeholder calls in December 2017 and February 2018. On April 30, 2018, MDPH and CDC initiated an enhanced field investigation (Figure 1).

Case Definition and Case Finding

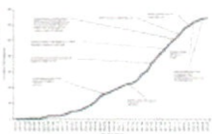


FIGURE 1— Cumulative HIV Diagnoses and Timeline of Investigation and Response to Outbreak of HIV: Massachusetts, 2015–2018

Note. CDC = Centers for Disease Control and Prevention; IDU = injection drug use; MDPH = Massachusetts Department of Public Health; PWID = people who inject drugs; SSP = syringe services program.

We included cases of HIV infection diagnosed during January 1, 2015, to June 30, 2018, that could be linked epidemiologically or molecularly to the investigation. Epidemiologically linked cases were HIV infections in PWID who received medical care, had experienced homelessness, resided or injected drugs in Lawrence or Lowell, or were injection or sex partners of these individuals. Molecularly linked cases were HIV infections with a partial HIV-1 polymerase (*pol*) gene nucleotide sequence linked at a genetic distance threshold of less than or equal to 0.015 substitutions per site[15] to a sequence from 1 or more cases with a connection to Lawrence or Lowell.

MDPH collects demographic, risk, and clinical information on all people who receive a diagnosis of HIV infection; test results from ongoing HIV care, such as CD4+ lymphocyte counts and HIV viral loads are also reported,[16] allowing longitudinal analyses. MDPH field epidemiologists interview people who received a diagnosis of HIV infection to assist in linkage to care and to identify and notify partners who may benefit from testing or other services.[17] Until November 2017, MDPH limited field follow-up to those with acute HIV infection and as requested by a health care provider.

Laboratory and Analytic Methods

HIV *pol* gene nucleotide sequences were generated at CDC after polymerase chain reaction amplification, as described elsewhere[12] or at commercial laboratories through similar gene amplification for genotypic testing for drug-resistance mutations. CDC's laboratory analyzed samples through November 2017 (30 samples), after which MDPH rapidly implemented statewide HIV molecular surveillance. Commercial laboratories reported HIV *pol* sequences to MDPH for Massachusetts residents who had a drug-resistance genotype test conducted as part of routine clinical care during January 2016 to September 2018. The presence of mutations was established through a standard algorithm (https://hivdb.stanford.edu/hivdb/by-sequences). We analyzed sequences with Secure HIV-TRACE[18] to identify molecular clusters with a pairwise genetic distance threshold of less than or equal to 0.015 substitutions per site (1.5%) and less than or equal to 0.005 substitutions per site (0.5%).[15]

We determined the recency of HIV infection through antibody avidity testing by using the modified Bio-Rad HIV-1/HIV-2 Plus O EIA (Bio-Rad Laboratories, Redmond, WA) as described in detail elsewhere.[18] We defined recent infection as an avidity index of less than or equal to 30%, indicating estimated infection within 221 days (95% confidence limits: 203.6, 238.7 days). We used MicrobeTrace (https://github.com/CDCgov/MicrobeTRACE/wiki) to construct diagrams of connections between cases and named contacts and of molecular links among cases to allow integration and visualization of both genetic and partner groups (Figure 2).

Assessment of Service Availability and Risk Behavior

To provide local context and to understand service availability, access, and HIV risk behaviors among PWID (including both drug use and sexual risk), we conducted semistructured interviews with stakeholders and both HIV-infected

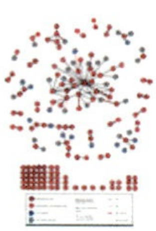


FIGURE 2— Network Diagram of Needle Sharing or Sex Partner Interactions, as of September 30, 2018, Stratified by HIV Status and

Molecular Cluster: Massachusetts, January 2015–June 2018

and non–HIV-infected PWID distinct from field epidemiology interviews. To be eligible for stakeholder interviews, participants needed to work with PWID in Lawrence or Lowell. Eligible PWID were aged 18 years or older, resided in Lowell or Lawrence, and reported IDU during the past 12 months.

We selected PWID for in-depth interviews by using a purposeful sampling technique to ensure variation based on sex, engagement in care, HIV status, and city of residence. Local stakeholders assisted investigators in identifying potential participants. Participants provided verbal consent and were reimbursed for their time.

RESULTS

Section: Choose

As of June 30, 2018, the conclusion of the intensive field investigation, a total of 129 people met the case definition. Ninety-four (73%) had received a diagnosis of HIV infection when aged 20 to 39 years, 55 (43%) were female, and 87 (67%) were non-Hispanic White (Table 1). The most commonly reported exposure mode was IDU (n = 111; 86%), with smaller percentages reporting male-to-male sexual contact and IDU (n = 5; 4%), male-to-male sexual contact only (n = 1; 1%), heterosexual contact or presumed heterosexual contact (n = 7; 6%), and no risk identified (n = 5; 4%; Table A, available as a supplement to the online version of this article at http://www.ajph.org). The initial CD4+ lymphocyte count was greater than or equal to 200 cells per cubic millimeter for 115 (89%) people, and the median earliest CD4+ count was 547 cells per cubic millimeter (Table A). Diagnoses peaked from April 2017 to January 2018 (Figure A, available as a supplement to the online version of this article at http://www.ajph.org). Of 116 (90%) individuals positive for either HCV antibody (indicating past or current infection) or HCV RNA (indicating current infection), 99 received a positive HCV test result before receiving the HIV diagnosis. A positive HCV antibody or RNA-positive test result was first recorded by MDPH at a mean of 56 (median = 45) months before HIV diagnosis.

TABLE 1—

Demographic Characteristics of Individuals Linked to an HIV Outbreak During January 1, 2015, to June 30, 2018: Massachusetts

During October 2017 to September 2018, viral load results were reported to MDPH for 113 (88%) cases, providing the most recent viral load test result taken within a year of analysis and allowing at least 3 months from latest possible time of diagnosis for viral suppression to be achieved. The most recently reported viral load during this period was less than 200 copies per milliliter (viral suppression) for 81 (63%) of 129, with a higher frequency of viral suppression among people who received a diagnosis during earlier years (Figure A).

Molecular Analysis and Recency Testing

Of 113 cases with available *pol* sequences, 102 (90%) were molecularly linked to 1 or more other cases at a genetic distance of less than or equal to 1.5%; of these, 93 linked to another case at a genetic distance of less than or equal to 0.5%. The linkages at a genetic distance of less than or equal to 1.5% formed 9 groups of 2 or more people, the 2 largest of which had 56 and 23 individuals, both including people from both Lawrence and Lowell. Of 129 cases, 36 (28%) without previously identified epidemiological links were initially linked by molecular analysis; by September 30, 2018, epidemiological links had been identified for 7 of these cases. As of September 30, 2018, 27 (21%) cases were only epidemiologically linked, 29 (22%) were only molecularly linked, and 73 (57%) were linked by both methods.

All cases in the 2 largest molecular clusters were HIV-1 subtype B. In the largest cluster, all *pol* sequences except 1 shared the nonnucleoside reverse transcriptase drug-resistance mutation K103N, which confers high-level resistance to nevirapine and efavirenz.

Of the 30 specimens tested for antibody avidity, 17 tested as recent (within 221 days) infections, and 13 were established infections. All people with results indicative of recent infection received HIV diagnoses within 3 months preceding specimen collection, and none were receiving antiretroviral treatment at the time of diagnosis.

Field Epidemiology

By September 30, 2018, field follow-up had been initiated for 120 (93%) people. Seventy-two interviewed individuals named 172 total contacts, representing 112 unique people. The 172 contact linkages formed 26 groups of 2 to 44 people. Seven groups included people from more than 1 molecular cluster (Figure 2). Needle sharing only accounted for 54% of partnerships; needle sharing and sex for 29%, and sex only for 17%. Ninety-eight (88%) named contacts had known connections to Lawrence or Lowell. Of 112 named contacts, 27 (24%) could not be contacted and were not tested for HIV infection, 13 (12%) tested HIV-negative, and 72 (64%) tested HIV-positive (Table B, available as a supplement to the online version of this article at http://www.ajph.org). Of these 72 people, 37 (51%) had received an HIV diagnosis before field epidemiology contact, 30 (42%) received HIV diagnoses because of field epidemiology contact, and 5 (7%) could not have a determination made based on available information.

In-Depth Interviews

Among 34 PWID interviewed, 20 reported injecting opioids, 4 stimulants, and 10 a combination of opioids and stimulants. Seven, all of whom used opioids, reported injecting more than 10 times per day. The increased frequency of injection associated with the introduction of fentanyl into the drug supply was prominent in interview responses. PWID were aware of the outbreak and of harm-reduction services in the area. PWID also reported frequent sharing of injection equipment and sharing of syringes when other options were unavailable. Sexual risk behavior for both women and men included exchanging sex for payment or drugs. All PWID interviewed had experienced homelessness within the past year.

We interviewed 19 stakeholders, including providers of substance use disorder services, HIV and emergency care, public health services, homelessness services, and law enforcement. Stakeholder interviews corroborated frequent injections associated with fentanyl use and common experiences of homelessness and incarceration among PWID. Prevention services in the region included an MDPH-funded SSP in Lawrence open 40 hours per week since January 2017, a privately funded SSP in Lowell open 4 hours per week since March 2018, and a privately funded mobile SSP that distributed injection equipment from a vehicle in both cities. SSPs distributed approximately 10 000 syringes in Lawrence in April 2018. Community health centers, hospital clinics, and private practices provided HIV testing, medication-assisted treatment, and HIV treatment in both cities; however, these services were not provided at emergency departments where PWID often presented for care[19] or homeless shelters. The clinical advisory issued by MDPH in November 2017 had not reached all targeted stakeholders by their report.

Public Health Response

In November 2017, in response to the outbreak, MDPH extended field epidemiology follow-up to people with new HIV diagnoses attributed to IDU and HIV diagnoses among people with positive HCV RNA or antibody results reported in the state's surveillance system. In May 2018, following a doubling of the team of field epidemiologists in Massachusetts, this was further extended to all new HIV diagnoses. Community involvement in response to the outbreak included consultative stakeholder meetings at the beginning and end of intensive field investigations that heightened stakeholder vigilance for HIV among PWID. SSP opening hours increased. An SSP in Lowell funded by MDPH following approval by the Lowell Board of Health was established in August 2018. HIV testing services were extended to emergency departments, homeless shelters, and jails. Total new HIV-related investment in the region by MDPH exceeded $1.7 million.

Following these interventions, MDPH surveillance recognized a substantial decrease in new IDU-related HIV diagnoses in the area. By June 4, 2019, the outbreak, including diagnoses since June 2018, had increased to 166 cases (35 only epidemiologically linked, 36 only molecularly linked, and 95 both epidemiologically and molecularly linked), including 7 outbreak-linked HIV diagnosis reports received in 2019, all between January and March). The outbreak-associated cases accounted for 52% of all HIV infection among PWID statewide in 2016 to 2017 and for all the increase in cases of HIV infection in PWID statewide (Figure 3).

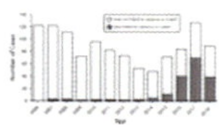


FIGURE 3— Diagnoses of HIV Among People Who Inject Drugs Statewide Showing Cases Linked to Lawrence and Lowell, Massachusetts: 2006–2018

[a]2018 data are preliminary.

DISCUSSION

Section: Choose

This outbreak of HIV infection, primarily among PWID, occurred in an urban area with longstanding opioid-related problems.[4,5] Unsafe injection practices were frequently reported. High-risk sexual behavior was also reported, and transmission of HIV occurred among people linked to the outbreak who did not report IDU. Molecular analysis supplemented field epidemiology, allowing characterization of the full extent of the outbreak and of networks of HIV transmission in circumstances in which interviews could not be conducted, and illustrated multiple introductions of HIV.

Beyond increasing the risk for overdose, fentanyl has been associated with more frequent injections because of its faster onset of effect and shorter duration of action.[4] Participants in the qualitative interviews who used opioids reported frequent injection, sometimes more than 10 times per day. Having decreased from 2006 to 2014,[10] annual new HIV diagnoses among PWID in Massachusetts increased beginning in 2015, shortly after fentanyl emerged in the drug supply.[4,7] A large proportion of this increase related to the outbreak, and a number of cases reported in other parts of the state were linked to the outbreak (Figure 2).

Syringe distribution through SSPs was insufficient for the high frequency of injection associated with fentanyl use. Increasing access to sterile injection equipment in hard-to-reach populations requires novel approaches, including mobile SSPs and encouragement of secondary syringe exchange, and programs to address community concerns.[20] SSP and medication-assisted treatment use decrease the risk for HCV infection[21,22] and HIV[23,24] transmission among PWID and help prevent outbreaks of HIV associated with IDU[24] by reducing sharing of injection equipment and frequency of injection, respectively. Shortly after the intensive field investigation, the Lowell Board of Health authorized an SSP; SSP funding from MDPH followed. MDPH expanded HIV testing through mobile testing services at SSPs and homeless shelters, and engagement with hospital emergency departments and substance use disorder treatment centers. MDPH has hired additional field epidemiologists and expanded follow-up to all people with newly diagnosed HIV infection.

Laboratory testing indicates that HIV infection was being diagnosed early in the course of disease for many, but not all, patients in this investigation. The median earliest CD4+ lymphocyte count (547 cells/mm^3) was higher in this outbreak than in Massachusetts overall during a similar time period (398 cells/mm^3; K. Cranston, MDPH, oral communication, November 9, 2018). Of the 30 samples available for antibody avidity recency testing, 17 (57%) indicated recent infection. Furthermore, the high proportion of cases molecularly linked at a genetic distance of less than or equal to 0.5% indicated recent transmission.

Despite very high health insurance coverage in Massachusetts[3] and all participants in qualitative interviews reporting having health insurance, challenges remain with engagement in and adherence to treatment and retention in care for people living with HIV. As of September 30, 2018, HIV viral suppression had been achieved in 63% of cases, and 12% had not had a viral load test within the previous year, compared with 79% viral suppression among all cases of HIV diagnosed across Massachusetts during 2015, as measured on January 1, 2018.[25]

Service providers cited homelessness and incarceration as common stressors for PWID. High levels of mobility and social instability may lead PWID to seek care in multiple locations, resulting in fragmentation of care or no care at all. Unpredictable release dates from incarceration and difficulty coordinating transition to care after release can produce interruptions in HIV care,[26] which providers noted despite MDPH-funded linkage-to-care services associated with county jails.

Astute clinicians noticed the increase above baseline in HIV diagnoses among PWID and notified MDPH. The local knowledge of stakeholders was valuable in understanding the context in which the outbreak developed and in guiding investigation and control efforts including provision of care and other services. Community meetings held at the start and end of intensive field investigations facilitated collaboration and introduction of HIV testing in homeless shelters. Despite the issuance of a clinical advisory, some stakeholders were unaware of the increase in HIV diagnoses early in the course of the outbreak. This revealed opportunities for improvement in communication among MDPH, local health departments, and other stakeholders.

Limitations to this investigation and outbreak response include the limited field epidemiology resources that constrained contact tracing. Although the providers we spoke to stressed the wide penetration of fentanyl into the local opioid supply, we were not able to review toxicology results from case-patients, and field epidemiology interviews did not ask about types of drugs used where individuals reported IDU. Results of qualitative interviews cannot be generalized to outbreak cases or the population of PWID. The investigation and publicity about the outbreak could have increased awareness among

PWID of the outbreak and local services. Although we explored temporal trends in volume of HIV testing and results of tests performed at the Massachusetts State Public Health Laboratory (data not shown), we lacked access to data from private laboratories and could not gauge the total volume of HIV testing over time. However, the number of positive HIV tests reported to MDPH from all clinical laboratories in the state and the proportion of positive tests performed at the Massachusetts State Public Health Laboratory remained consistent over the past decade, indicating that testing availability has been consistent. Furthermore, the median earliest CD4+ count was higher among those involved in this outbreak than among all cases of HIV diagnosed in the state, indicating that testing is accessed by PWID in Lawrence and Lowell.

To conclude, despite health insurance coverage and harm-reduction services, HIV emerged among PWID in the context of homelessness, incarceration, and other determinants of HIV risk.[27] Because of more frequent injection, fentanyl may have increased the opportunity for HIV transmission. Similar environments exist in many other US cities, especially in Massachusetts and across New England where fentanyl is widespread.[28,29]

Longstanding community partnerships helped with detection and response to this outbreak and illustrate the importance of collaborations between public health and local stakeholders. Molecular surveillance helped characterize this outbreak, and its expanded use will aid future outbreak detection and characterization to enable prompt investigation and intervention. The decline in new outbreak-linked HIV diagnoses since the implementation of control measures demonstrates the value of a timely response to an increase in HIV diagnoses.

Prevention of future outbreaks will require the preemptive deployment of services, including SSPs, medication-assisted treatment for opioid use disorder,[30] targeted HIV testing, and case management to minimize HIV transmission among PWID and maximize retention in care and viral suppression among people living with HIV. National efforts to eradicate HIV infection depend on this level of readiness and response, particularly in populations such as PWID with currently low rates of new HIV infection, but with the potential for viral reintroduction and rapid transmission.

ACKNOWLEDGMENTS

The authors would like to acknowledge Chris Bositis and Amy Bositis in Lawrence, Massachusetts, and Kerran Vigroux, Jaime Dillon, Judy Lethbridge, and The Community Opioid Outreach Program in Lowell, Massachusetts, for their work with people living with HIV and people who use drugs in northeast Massachusetts. We would also like to thank Wei Luo and Silvina Masciotra of the Division of HIV/AIDS Prevention at CDC for their work with recency testing of HIV samples related to this outbreak.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

HUMAN PARTICIPANT PROTECTION

The investigation was approved by CDC as a nonresearch disease control activity in accordance with federal human participant protection regulations and CDC policies and procedures.

References

1. Fauci AS, Redfield R, Sigounas G, Weahkee M, Giroir B. Ending the HIV epidemic, a plan for the United States. JAMA. 2019;321(9):844–845. Crossref, Medline, Google Scholar
2. Oster AM, France AM, Mermin J. Molecular epidemiology and the transformation of HIV prevention. JAMA. 2018;319(16):1657–1658. Crossref, Medline, Google Scholar
3. US Census Bureau. American Community Survey Data Profiles 2012–2016 5 year estimate. Available at: https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2016. Accessed October 23, 2018. Google Scholar
4. Ciccarone D, Ondocsin J, Mars S. Heroin uncertainties: exploring users' perceptions of fentanyl-adulterated and -substituted "heroin." Int J Drug Policy. 2017;46:146–155. Crossref, Medline, Google Scholar
5. Massachusetts Department of Public Health. Data brief: opioid-related overdose deaths among Massachusetts residents, 2017. Available at: https://www.mass.gov/files/documents/2018/02/14/data-brief-overdose-deaths-february-2018.pdf. Accessed October 23, 2018. Google Scholar

6. Centers for Disease Control and Prevention. Hepatitis C virus infection among adolescents and young adults—Massachusetts, 2002–2009. MMWR Morbid Mortal Wkly Rep. 2011;60(17):537–541. Medline, Google Scholar

7. Massachusetts Department of Public Health. An assessment of fatal and nonfatal opioid overdoses in Massachusetts (2011–2015), August 2017. Available at: https://www.mass.gov/files/documents/2017/08/31/legislative-report-chapter-55-aug-2017.pdf. Accessed October 23, 2018. Google Scholar

8. CDC WONDER. Multiple Cause of Death 1999–2016. Centers for Disease Control and Prevention, National Center for Health Statistics. 2015. Available at: https://wonder.cdc.gov. Accessed October 23, 2018. Google Scholar

9. Massachusetts Department of Public Health, Bureau of Infectious Disease and Laboratory Services. Massachusetts Integrated HIV/AIDS Prevention and Care Plan. September 1, 2018. Available at: https://www.mass.gov/files/documents/2018/01/09/mass-hiv-aids-plan.docx. Accessed January 25, 2019. Google Scholar

10. Massachusetts Department of Public Health. Massachusetts HIV/AIDS epidemiological profile: people who inject drugs, 2017. Available at: https://www.mass.gov/files/documents/2018/06/25/idu.docx. Accessed October 23, 2018. Google Scholar

11. Des Jarlais DC, Kerr T, Carrieri P, Feelemyer J, Arasteh K. HIV infection among persons who inject drugs: ending old epidemics and addressing new outbreaks. AIDS. 2016;30(6):815–826. Crossref, Medline, Google Scholar

12. Peters PJ, Pontones P, Hoover KW, et al. HIV infection linked to injection use of oxymorphone in Indiana, 2014–2015. N Engl J Med. 2016;375(3):229–239. Crossref, Medline, Google Scholar

13. Golden MR, Lechtenberg R, Glick SN, et al. Outbreak of human immunodeficiency virus infection among heterosexual persons who are living homeless and inject drugs—Seattle, Washington, 2018. MMWR Morb Mortal Wkly Rep. 2019;68(15):344–349. Crossref, Medline, Google Scholar

14. Massachusetts Department of Public Health Bureau of Infectious Disease and Laboratory Science. Clinical advisory: HIV transmission through injection drug use. November 27, 2017. Available at: https://www.mass.gov/lists/hiv-treatment-guidelines-and-clinical-advisories. Accessed October 23, 2018. Google Scholar

15. Oster AM, France AM, Panneer N, et al. Identifying clusters of recent and rapid HIV transmission through analysis of molecular

surveillance data. J Acquir Immune Defic Syndr. 2018;79(5):543–550. Crossref, Medline, Google Scholar

16. Commonwealth of Massachusetts. 105 CMR 300.000: Reportable diseases, surveillance, and isolation, and quarantine requirements. Available at: https://www.mass.gov/regulations/105-CMR-30000-reportable-diseases-surveillance-and-isolation-and-quarantine. Accessed October 23, 2018. Google Scholar

17. Massachusetts Department of Public Health, Bureau of Infectious Disease and Laboratory Science. Guide to surveillance, reporting and control. 2018. Available at: https://www.mass.gov/handbook/guide-to-surveillance-reporting-and-control. Accessed October 23, 2018. Google Scholar

18. Centers for Disease Control and Prevention. Detecting and responding to HIV transmission clusters. A guide for health departments. June 2018. Available at: https://www.cdc.gov/hiv/pdf/funding/announcements/ps18-1802/CDC-HIV-PS18-1802-AttachmentE-Detecting-Investigating-and-Responding-to-HIV-Transmission-Clusters.pdf. Accessed January 2, 2019. Google Scholar

19. Nambiar D, Spelman T, Stoové M, Dietze P. Are people who inject drugs frequent users of emergency department services? A cohort study (2008–2013). Subst Use Misuse. 2018;53(3):457–465. Crossref, Medline, Google Scholar

20. Benyo A. Promoting secondary exchange: opportunities to advance public health. Harm Reduction Coalition. 2006. Available at: https://harmreduction.org/wp-content/uploads/2012/01/promotingsecondaryexchange.pdf. Accessed October 23, 2018. Google Scholar

21. Platt L, Minozzi S, Reed J, Vickerman P, et al. Needle syringe programmes and opioid substitution therapy for preventing hepatitis C transmission in people who inject drugs. Cochrane Database Syst Rev. 2017:(9):CD012021. Medline, Google Scholar

22. Morris MD, Shiboski S, Bruneau J, et al. Geographic differences in temporal incidence trends of hepatitis C virus infection among people who inject drugs: the InC3 Collaboration. Clin Infect Dis. 2017;64(7):860–869. Crossref, Medline, Google Scholar

23. Janowicz DM. HIV transmission and injection drug use: lessons from the Indiana outbreak. Top Antivir Med. 2016;24(2):90–92. Medline, Google Scholar

24. Strathdee SA, Beyrer C. Threading the needle—how to stop the HIV outbreak in rural Indiana. N Engl J Med. 2015;373(5):397–399. Crossref, Medline, Google Scholar

25. Massachusetts Department of Public Health, Bureau of Infectious Disease and Laboratory Sciences. 2018Massachusetts HIV/AIDS epidemiologic profile. The Massachusetts HIV Care Continuum. Available at: https://www.mass.gov/lists/hivaids-epidemiologic-profiles. Accessed June 27, 2019. Google Scholar
26. Hammett TM, Donahue S, LeRoy L, Montague BT. Transitions to care in the community for prison releasees with HIV: a qualitative study of facilitators and challenges in two states. J Urban Health. 2015;92(4):650–666. Crossref, Medline, Google Scholar
27. Centers for Disease Control and Prevention. Social determinants of health among adults with diagnosed HIV infection in 13 states, the District of Columbia, and Puerto Rico, 2015. HIV Surveillance Supplemental Report. August 2017;22(3). Available at: http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html. Accessed October 23, 2018. Google Scholar
28. Springer YP, Gladden RM, O'Donnell J, Seth P. Notes from the field: fentanyl drug submissions—United States, 2010–2017. MMWR Morb Mortal Wkly Rep. 2019;68(2):41–43. Crossref, Medline, Google Scholar
29. Drug Enforcement Administration National Forensic Laboratory Information System. NFLIS Brief: Fentanyl, 2001–2015. March 2017. Available at: https://www.nflis.deadiversion.usdoj.gov/DesktopModules/ReportDownloads/Reports/NFLISFentanylBrief2017.pdf. Accessed March 31, 2019. Google Scholar
30. Van Den Berg C, Smit C, Van Brussel G, et al. Full participation in harm reduction programmes is associated with decreased risk for human immunodeficiency virus and hepatitis C virus: evidence from the Amsterdam Cohort Studies among drug users. Addiction. 2007;102(9):1454–1462. Crossref, Medline, Google Scholar

American Journal of Public Health®
800 I Street NW, Washington, DC 20001-3710
202-777-2742

Print ISSN: 0090-0036 | Electronic ISSN: 1541-0048

<u>Board of Health Meeting – February 5, 2019</u>
Community Health Division, Lowell Health Department

Community Health Coordinator (CHC)
Kate Elkins

Healthy Lowell Week

- In recognition of National Public Health Week, the Health Department (HD) will be once again coordinating "Healthy Lowell Week" taking place this year from April 6-12, 2020 in partnership with the Greater Lowell Health Alliance, Lowell General Hospital, Lowell Community Health Center, UMass Lowell, and other community partners
    - *Event schedule can be found at https://bit.ly/healthylowellweek*
- Additional activities will take place during the week at the HD, such as staff participation in the Mass DPH Ounce of Prevention Conference and efforts to recognize and appreciate HD employees

Healthy Living in Lowell

- The CHC produced a February episode of Healthy Living in Lowell focused on Stroke Health and featuring Silvana Flynn from Lowell General Hospital.
- A March show will focus on women's health.

Access to Equitable Physical Activity

- The City of Lowell was awarded a grant from the Blue Cross Blue Shield of Massachusetts Foundation to establish more equitable opportunities for physical activity in Lowell over a three-year period.
- The walking routes project, now named, "Healthy Walking Trails" is moving along and the CHC will be working with the Planning and Development department to perform outreach in the Centralville neighborhood to get the project off the ground.

Employee Health and Wellness

- The CHC and the city's health and wellness committee created a schedule of programs for the 2020 calendar year and submitted a memo to the City Manager's office. *Schedule attached.*

Vision 2020 Grant

- The Health Department was awarded funding from the Greater Lowell Health Alliance in October to implement a new vision program within the School Health Unit. This grant will assist with better screening equipment for our youngest children and an enhanced vision referral system. The CHC wrote the grant and is now assisting the School Health Unit with some of the grant objectives.
- A Welch Allyn SPOT vision screener has been procured and testing of students 3-5 years of age has begun. The Vision Screeners are excited to have this state of the art machine to use.
- Prevent Blindness is continuing to consult on improved referrals systems and so far has provided us with a systems flow chart, updated letters to parents, updated physician result forms, and more.

Spacers for Kids Project

- The Greater Lowell Health Alliance awarded the Greater Lowell Community Foundation (GLCF) with grant funds to launch a new initiative titled, Asthma Spacers for School Kids. This program aims to provide free spacers to school-aged children with a known asthma diagnosis in the Greater Lowell region.
- Spacers have been distributed to the school nurses for distribution to students.

Sun Safety Initiative

- The CHC will once again work with Impact Melanoma to provide sun safety programming and education for the 2020 summer season. In addition to the five water sites where sunscreen dispense kiosks were placed, we will add up to 8 new dispensers at athletic fields and recreation camps – all disposers are free and open to the public.

Additional Notes

- The CHC is planning a maternity leave for April – July and is actively working on planning for this process during this time.
- The CHC has two interns this semester, Michael Rivera from UML and Victoria Consuelo from Northern Essex CC.
- The CHC is assisting the Substance Abuse and Prevention division in applying for a federal SAMHSA grant.

City of Lowell Employee Health and Wellness Program

Mission: To provide all employees with the resources and support they need to take action in achieving optimal health and wellness.

Timeline: 2020 Calendar Year

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Admin Tasks	Steering Committee Meets	x	x	x	x	x	x	x	x	x	x	x	x
	Send Memo to City Manager for 2020 plans	x											
	Biometric Screening Program Research						x	x	x				
	Planning for 2021											x	x
Programs	Monthly Health and Wellness E-Blast	x	x	x	x	x	x	x	x	x	x	x	x
	Onsite Wellness Program	x	x	x	x	x	x			x	x	x	x
	Wellness Tracking Platform	x	x	x	x	x	x	x	x	x	x	x	x
	Employee Step Challenge				x	x				x	x		
	Employee Community Service		x		x	x				x			
	Employee Health and Wellness Fair										x		
Additional: Offer "mini-grants" to departments that want to host their own health and wellness activities, if funds are available.													

Lowell Health Department Public Health Nursing

December 2019

Submitted by Colleen da Silva, RN, BSN

Communicable Diseases Reported

Disease	Dec. 2018	Dec. 2019	2018 Total	2019 Total
Amebiasis				
Anthrax			1	
Arbovirus	1		2	1
Babesiosis			4	1
Borrelia miyamotoi infection			1	
Botulism	1		1	
Calcivirus/Norovirus	2		5	2
Campylobacteriosis	1	1	15	15
Clostridium perfringens			1	
Cryptococcus neoformans			1	1
Cryptosporidiosis	5		19	10
Cyclosporiasis				1
Dengue Fever			1	2
Ehrlichiosis			1	3
Enterovirus				
Giardiasis	1	2	16	27
Group A Streptococcus	2	7	59	57
Group B Streptococcus	1	1	14	11
Haemophilus Influenzae			1	2
Hepatitis A	2	1	8	12
Hepatitis B	6	9	117	113
Hepatitis C	17	13	212	202
Hepatitis D				1
Human Granulocytic Anaplasmosis			11	3
Influenza	157	220	1726	1233
Invasive bacterial infection (other)			1	2
Legionellosis	1		11	9
Lyme Disease	2	1	74	66
Malaria	1		2	3
Measles			1 confirmed 29 contacts 10 revoked	7 revoked
Meningitis – Unknown Type		1	1	4
Meningococcal Disease				1

Mumps			1 probable 1 revoked 2 suspect	1 revoked 1 suspect
Pertussis (and other Bordatella species)			1	1
Rocky Mountain Spotted Fever			1	
Rubella			1	
Salmonellosis	1		18	21
Shiga toxin producing organism			1	
Shigellosis			1	1
Streptococcus pneumoniae	3		19	5
Toxoplasmosis			1	
Varicella			9	15
Viral Meningitis (aseptic)			1	2
West Nile Virus Infection				1
Yersiniosis				
Zika Virus Infection			1	

*denotes case is connected to a foodborne illness investigation

Tuberculosis Cases Reported

	Dec. 2018	Dec. 2019	2018 Total	2019 YTD
TB LTBI	25	37	341	377
TB Active	0	1 revoked	9 confirmed 19 revoked	10 confirmed 11 revoked 2 suspect
B1 Waivers	0	0	14	9

Total of 37 DOTs done in December 2019

Refugee Arrivals

Total Families/Total Persons

Dec. 2018	Dec. 2019	2018 Total	2019 Total
1/4	6/10	29/76	27/80

Immunizations

Vaccine	Dec. 2018	Dec. 2019	2018 Total	2019 Total
Influenza	1	0	372	331
Hepatitis A	4	0	4	0

Public Health Nurse Activities

Participated in Medication Take Back Day held at Health Department

Attended Health and Medical Care Coalition (HMCC) quarterly meeting in Reading

Attended Mass. Assoc. of Public Health Nurses meeting at Tewksbury State Hospital

Participated in 2nd Planning Meeting for Emerging Infectious Disease Table Top Exercise that will be held in January 2020.

Public Health Nurse Manager Activities

Participated in Medication Take Back Day held at Health Department

Attended Health and Medical Care Coalition (HMCC) quarterly meeting in Reading

Attended Mass. Assoc. of Public Health Nurses meeting at Tewksbury State Hospital

Participated in 2nd Planning Meeting for Emerging Infectious Disease Table Top Exercise that will be held in January 2020.

Board of Health December 2019

School Health Unit

Nurse Coordinator and Clinical Managers worked in collaboration at the following meetings : School Department Health & Wellness Committee, Greater Lowell Asthma Coalition Committee. Nurse Coordinator attended the Greater Lowell Community Foundation Board meeting to thank them for the 2000 spacers that they gave to the Health Department to distribute to the Lowell Public School students who have asthma and to explain to them the importance of the use of a spacer when using an inhaler. Also met with LCHC vision staff so we can work in collaboration with them to increase the number of students to receive a comprehensive eye exam after having failed our vision screen and the results will be shared with the School Nurse.

School Nursing Services Provided	18-Dec	19-Dec	Total 18-19	YTD 2018	YTD 2019
Total Student Encounters					
Totals	12,567	9,742	135,213	55,910	55,991
911 Emergency Calls					
Student	7	7	68	34	25
Staff	-	2	14	10	7
Medication Administration					
Totals	3,724	2,906	44,159	15,948	14,633
Nursing Assessment					
Student	7,731	6,225	86,821	37,419	38,136
Staff	41	37	385	205	173
Glucose Testing	551	437	6,631	2,771	2,541
Nausea/vomiting	999	727	11,071	4,336	4,101
Tube Feedings	202	124	2,473	799	707
pulse Oximetery	10	9	328	67	71
Screenings					
Vision	529	672	9,116	4,309	3,681
Hearing	610	677	7,098	3,070	2,689
BMI	507	429	2,919	1,192	1,802
Postural	123	479	4,304	367	776

<u>Board of Health Report – February 5th, 2020</u>

Substance Abuse and Prevention Division, Lowell Health Department

Substance Abuse Coordinator, Division Manager

Lainnie Emond, LMHC

Prescription Drug Monitoring Program (PDMP) Grant Initiatives:

- Continuing to work with the Co-Chairs of the Mayor's Opioid Epidemic Crisis Task Force to plan monthly meeting agendas, identify potential initiatives, contact presenters, and invite new agencies to participate.
  - *Recent and Upcoming Meetings: January 27th and February 24th from 5:30-6:30pm.*
- Continuing to lead Data Subcommittee of the Mayor's Opioid Task Force. Subcommittee members are working to finalize the fifth "Opioid Trends in Lowell, MA" report, which focuses on HIV and opioid-overdose risk factors in Lowell. The Data Subcommittee is also working to create a "2019 Summary" report that reviews data for fatal and nonfatal opioid overdoses, as well as highlights successes of our community partners.
- Continuing to co-lead Media Subcommittee meeting of the Mayor's Opioid Task Force. Subcommittee released a press release highlighting winter weather risk factors for opioid overdose.
- Continuing to working to identify a specific documentation system to demonstrate how the Substance Abuse Coordinator (SAC) position and the Substance Abuse and Prevention Division have impacted the Lowell Health Department and provider community. This information is important to incorporate into grant reporting as the SAC position has positively expanded beyond the expectations written into the grant.

Lowell CO-OP and Related Efforts:

- Lainnie continues to be involved in administrative planning for the Lowell CO-OP, including co-facilitating Lowell CO-OP Supervisors Meetings and working with team and grant partners to ensure effectiveness of the team.
- Lainnie and Maricia, the Lowell CO-OP Supervisor, held first and second round interviews for the Clinical Recovery Specialist position. A candidate recommendation has been made.

Additional Substance Abuse Coordinator Activities:

- Managing daily activities of the Substance Abuse and Prevention Division.
- Lainnie continues to be the point person for www.DrugFreeGreaterLowell.org. Marketing materials have been designed and are being distributed to partners in Greater Lowell, which include an email signature, social medial images, 11x18 foam boards, business cards, and pens.
- Lainnie will be attending the Community Anti-Drug Coalitions of America (CADCA) Annual National Leadership Forum from February 3rd through February 7th. Expenses are paid for by the Tewksbury Substance Abuse Prevention Collaboration, which Lainnie is a member of.
- Lainnie is continuing to work with colleagues from Tufts University and Trinity EMS to work on a scientific research paper examining how EMS interacts with patients prior to experiencing a fatal overdose.

Massachusetts Opioid Abuse Prevention Collaborative (MOAPC)

*** Lainnie Emond will oversee the MOAPC Grant through the end of the grant cycle, June 30th, 2019. ***

Strategy One (implement Life Skills Training across the cluster): *Life Skills Training is an evidenced based prevention curriculum supported by the Bureau of Substance Addiction Services.*

- No updates at this time.

Grant Strategy Two (coordination and promotion of education on harm reduction strategies):

- Several organizations within the MOAPC cluster offer Narcan training and Narcan kits.

Drug Free Greater Lowell Website

- www.DrugFreeGreaterLowell.org is live. The MOAPC grant funded informational business cards and other outreach materials to promote the website.

Unwanted Medication and Sharps Disposal

- The Lowell Health Department is hosting its first Unwanted Medication and Sharps Disposal day on March 10th from 2-6pm at 341 Pine Street, Lowell, MA.

Other

- Began discussion with MOAPC Coalition and grant funder to hire a contractor to analyze data, wrap up the MOAPC grant, and assess the current status of the MOAPC coalition via something similar to a SWAT analysis. More information to follow.

Partnerships for Success (PFS)

*** Lainnie Emond will act as interim coordinator of the PFS grant until the position is filled. ***

Strategy One (social media and education dissemination to high school-aged youth re: sharing prescription medications):

PFS Social Media Campaign:
- Social media campaign has been placed on hold until a new PFS Coordinator is hired.

Strategy Two (social media and education dissemination to parents/guardians and high school-aged youth re: proper disposal and storage):

"Help Keep Our Kids Safe" Campaign
-Community Health Coordinator, Kate Elkins, has completed a two-sided handout giving tips on the proper storage of prescription medication as well as identifying medication disposal sites in Lowell. Kate worked with a contracted graphic designer to create the handout format, and worked with Lainnie to create the handout content. This handout will be distributed to the general public with a specific focus on parents/caregivers of local youth. This handout has been sent to Lowell PFS's assigned BSAS Grant Contract Manager and Technical Assistance Liaison for final approval.

Monthly Meeting:
The January coalition meeting was postponed until February 26th from 1-2pm at the Lowell Health Department.

Outreach Health Educator Position:
A candidate recommendation has been made to Human Resources.

Lowell Community Opioid Outreach Program (CO-OP)
Maricia Verma, Lowell CO-OP Supervisor

Lowell CO-OP Data 2019

--	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total Encounters	78	76	32	47	88	58	41	48	74	33	41	51	**667**
Unique Encounters	--	37	28	29	52	34	28	36	53	16	34	31	**378**
Initial Interaction	--	9	6	9	17	3	7	13	12	2	15	7	**100**
OD Follow-Up	2	8	9	11	17	3	6	9	29	4	10	8	**116**
Section 35	2	1	0	1	5	1	1	2	2	0	5	0	**20**
Clinical Clients	7	7	5	4	3	2	2	2	2	2	2	2	**40**
Disseminate Narcan	0	0	3	6	13	4	20	5	25	5	37	23	**141**
SUD Treatment	11	15	14	12	14	14	18	14	22	11	8	5	**158**
Medical Treatment	0	1	0	5	3	4	4	5	4	1	1	5	**33**
Other Services	7	1	2	8	4	8	3	2	11	1	0	0	**47**
Misc. Outreach	--	--	--	--	--	156	223	464	71	72	132	463	**1581**

Outreach and Educational Events

Date	Event Type	Location	Topic	Attendance
12-9-2019	Presentation	UMass Lowell; Criminal Justice Class	CO-OP Services	20

Relationship Building

Date	Organization	Relationship Building
01-09-2020	Community Healthcare Alliance	CO-OP Supervisor and team , to meet and discuss collaboration and services.
01-21-2020	Place of Promise	CO-OP Supervisor, and team, to meet and discuss collaboration and services.

Additional

- First round interviews for the Clinical Recovery Specialist position were held the first week of January and second round interviews were held the third week of January. Candidate recommendation has been made.
- Lowell CO-OP brochure is being finalized. Once finalized, will be printed and distributed.

Syringe Collection Program

Andres Gonzalez, Syringe Collection Program Coordinator

City Department and Community Partner Engagement:

- Lowell Public Library
- Lowell Career Academy
- Lowell City Council
- Trinity EMS
- Lowell House Inc.
- Lowell Housing Authority
- Healthy Streets
- Hunger Homeless Commission
- MVRTA
- Lowell Community Health Center
- Office of the City Manager
- Lowell CO-OP
- Department of Planning & Development
- Lowell Street Department
- Lowell Police Department
- Lowell Parks Department

Community Events Attended:

- 12/13 Greater Lowell Opioid Task Force
- 12/17 Merrimack Valley Reginal Transit Authority (MVRTA)
- 12/18 Lowell Housing Authority
- 12/19 South Common Village Tenant Association – (Sharps Education & Outreach)
- 12/20 Lowell SSP Stakeholders Meeting
- 1/7 Lowell Career Academy
- 1/10 Greater Lowell Opioid Task Force
- 1/22 Homeless Providers Coordination Meeting

Areas Proactively Swept for Discarded Syringes:

- Hunts Falls Bridge
- George Street
- Favor Street
- Lowell Justice Center
- Rogers Street Bridge
- South Common Park
- North Common Park
- Thorndike Overpass
- Eastern Canal Park
- La Lachuer Park
- Concord River
- Point Park
- Bridge Street Park
- River Bike Path
- Lincoln Street

Syringe Collection Activity 2019 and 2020

Total Number Of…	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 1st-22nd	Total
Discarded syringe pick-up requests*	8	6	8	21	22	35	38	22	8	12	**180**
Incoming calls for syringe pick-up requests**	6	22	21	17	14	14	14	11	7	8	**134**
Syringes picked-up while responding to **all** discarded syringe pick-up requests	49	240	334	265	157	337	322	113	22	290	**2,129**
Syringes picked up during Community Clean-up Events	0	11	75	49	16	131	161	0	0	0	**433**
Syringes proactively picked-up while in the community	493	967	488	1231	895	1040	845	896	635	838	**8,328**
Hours proactively picking-up discarded syringes in the community	9	20	25	29	41	49	35	44	27	33	**294**

**Discarded syringe pick-up request from City Employees (ie. police, fire) and Trinity EMS.*

***Discarded syringe pick-up request from Lowell residents.*

Community Outreach Educator
Linda Bellantoni

Linda's role focuses on enhancing the outreach efforts of the Substance Abuse and Prevention Division.

City Department and Community Partner Engagement*:*

- Linda built relationships with the following community partners:
  - THRIVE
  - Megan's House
  - Lowell Senior Center
  - Pollard Memorial Library
  - Veterans Center
  - Lowell CO-OP

Community Events Attended*:*

- 1/7 Greater Lowell Health Alliance –Substance Use Prevention. Saints Campus-Lowell General Hospital
- 1/10 District Attorney's Opioid Task Force
- 1/15 "Morning with Millie" Mayors Reception Room-City Hall
- 1/22 Lowell Community Health Center- Teen Block Open House.
- 1/23 Center for Family Therapies

Outreach Education:

- 1/29 Middlesex Community College - Wellness Wednesday
  - Topics of focus will include signs of an opioid overdose and Syringe Collection Program
- 2/17 Lowell Kids Week *(kids and parents)*
  - Topics of focus will include safe syringe disposal/storage and medication disposal